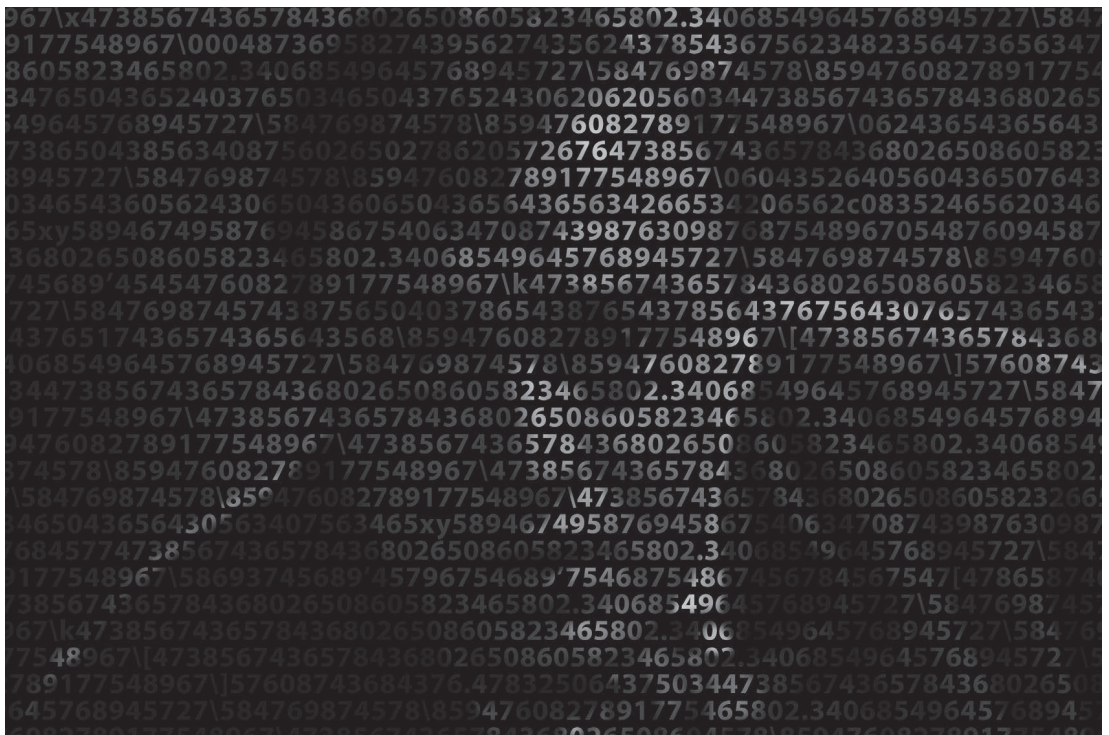




Angelo Zappalà

# Separating Deviant and Non-Deviant Sexual Preferences with a Dual-Target Rapid Serial Visual Presentation Task





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Angelo Zappalà

Psychology  
Faculty of Arts, Psychology and Theology  
Åbo Akademi University  
Åbo, Finland, 2016

**Supervised by**

Professor Pekka Santtila, PhD

Professor of Applied Psychology, Faculty of Arts, Psychology and Theology, Åbo Akademi University, Finland

Professor N. Kenneth Sandnabba, PhD

Professor of Applied Psychology, Faculty of Arts, Psychology and Theology, Åbo Akademi University, Finland

Dr. Jan Antfolk, PhD

University researcher, Faculty of Arts, Psychology and Theology, Åbo Akademi University, Finland

**Reviewed by**

Professor Antony Beech

Professor in Criminological Psychology, Head of the Centre for Forensic and Criminological Psychology, School of Psychology, University of Birmingham, United Kingdom

Dr. Carmen Gress, PhD

Director of Research, Planning, and Offender Programming with British Columbia Corrections, Ministry of Justice  
Canada

**Opponent**

Professor Antony Beech

Professor in Criminological Psychology  
Head of the Centre for Forensic and Criminological Psychology  
School of Psychology  
University of Birmingham  
Birmingham  
United Kingdom

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*“Sleeping or Awake?”*

This is the SMS I received on a Friday morning, a few years ago, from Professor Pekka Santtila.

After receiving my affirmative answer, Prof. Santtila phoned to inform me that the Academy of Finland had decided to fund a research project I had been working on over the past years, and which laid the foundation of this thesis. That is how it all started.

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This professor from Turin said: "I received this email ... take care of it ... there is this guy who wants to work with us ... he is a Finn."

"He is a Finn". This is how it all started.

This extraordinary adventure began with a young Finnish Psychologist, working at the Police College of Finland, waiting for me at Helsinki airport, holding a sign with my name.

While writing these acknowledgements, I am turning one of the most beautiful pages of my life.

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I thank my brother, who showed me where will, passion and determination can lead you.

They have donated to me an endless supply of love that I will carry in my heart forever.

Turin, Åbo. April 1, 2016

A handwritten signature in cursive script, appearing to read "Amy Neftci", written in a light purple or blue ink.

# List of publications

## **Study I**

Antfolk, J., Zappalà, A., Dombert, B., Räfså, A., Mokros, A., & Santtila, P. (submitted). Target-detection rates in the dual-target RSVP as a measure of sexual preference in men.

## **Study II**

Zappalà, A., Antfolk, J., Bäckström, A., Dombert, B., Mokros, A., & Santtila, P. (2013). Differentiating sexual preference in men: using dual task rapid serial visual presentation task. *Scandinavian Journal of Psychology*, 54, 320–327.

## **Study III**

Zappalà, A., Antfolk, J., Dombert, B., Mokros, A., & Santtila, P. (2015). Identifying deviant sexual interest in a forensic sex offender population using Dual-target Rapid Serial Visual Presentation Task. *Journal of Forensic Psychiatry & Psychology*.

## **Study IV**

Zappalà, A., Antfolk, J., Dombert, B., Mokros, A., & Santtila, P. (2013). Using a dual-target Rapid Serial Visual Presentation Task (RSVP) as an attention-based measurement procedure of sexual preference: is it possible to fake? *Psychiatry, Psychology and Law*, 20 (1), 13, 73-90.

## **Study V Stimulus Development Study (SDS-Study)**

Dombert B., Mokros A., Brückner E., Schlegl V., Antfolk J., Bäckström A., Zappalà A., Osterheider M., Santtila P. (2013). The Virtual People Set: Developing computer-generated stimuli for the assessment of pedophilic sexual interest. *Sexual Abuse: A Journal of Research and Treatment*, 25 (6), 557-582.

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## Svensk sammanfattning

Forskning visar att avvikande sexuell preferens (ASP) är en av de viktigaste prediktorerna för återfall i sexualbrott. Därför är det viktigt att ha valida och standardiserade verktyg för att kunna bedöma ASP i såväl juridiskt beslutsfattande som i behandling av sexualförbrytare. Under de senaste decennierna har flera både fysiologiska och icke-fysiologiska metoder för att bedöma DSP utvecklats. För att överkomma några av de begränsningar och problem som finns hos de tillgängliga metoderna så har man under senare år fokuserat forskningen på uppmärksamhetsbaserade metoder.

Denna avhandling var en del av ett forskningsprojekt som avsåg utveckla uppmärksamhetsbaserade metoder för bedömning av ASP. Mer specifikt var syftet med avhandlingen att utveckla en s.k. Rapid Serial Visual Presentation (dtRSVP) metod för att identifiera ASP. Innan vi testade kriminella urval av sexualbrottslingar så genomförde vi tre studier för att kalibrera förfarandena. I dessa studier undersökte vi möjligheten att differentiera mellan homosexuella och heterosexuella män och vi undersökte även hur enkelt försökspersonerna kunde fuska.

Dessutom skapade vi en ny uppsättning stimuli för bedömningen av pedofilt sexuellt intresse. I skapandet av dessa stimuli togs de etiska och juridiska problemen i beaktande så långt som möjligt. Vidare är dessa stimuli standardiserade för att maximera den interna validiteten i det experimentella arbetet.

I studierna 1, II och IV testade vi totalt 39 homo- och 39 heterosexuella män. I studie III testade vi 69 manliga barnsexförbrytare och 145 manliga kontroller. Sextiofem män och 65 kvinnor, och 47 manliga barnsexförbrytare och 59 manliga kontroller deltog i studie IV. Studie V (SDS-studien) bestod av tre delstudier. I SDS-studie 1, deltog 20 försökspersoner (10 kvinnor, 10 män), i SDS-studie 2, deltog 110 försökspersoner (55 män, 55 kvinnor), i SDS-studie 3, deltog 106 män. Av dessa var 59 män ett urval från den allmänna populationen

och 47 personer var interner som dömts för innehav eller spridning av barnpornografi.

I studie I, II, III och IV ombads deltagarna att identifiera två svarta inramade s.k. målbilder som presenterats i en ström av 12 stimuli (där två målbilder ingår) i ett dtRSVP förfarande (se figur 1, sid. 33).

I **studie I** undersökte vi hur verkliga sexuella preferenser modererade informationsbehandlingen av sexuellt relevanta bilder. I denna studie ombads deltagarna att identifiera könet på de personer som presenteras och om dessa personer var nakna eller påklädda.

I **studie II** undersökte vi om dtRSVP kan användas för att differentiera sexuell läggning hos män. I denna studie ombads deltagarna att identifiera könet på de personer som presenteras och huruvida dessa personer var en tonåring eller vuxen (Tanner 4/5) eller yngre än en tonåring (Tanner 1-Tanner 2/3) (de visuella stimuli var datorgenererade bilder av nakna och påklädda personer från Virtual People Set, VPS).

I **studie III** undersökte vi om dtRSVP kan användas för att identifiera sexuellt intresse hos män. I denna studie ombads deltagarna att identifiera könet på de personer som presenterades och huruvida dessa personer var en tonåring eller en vuxen (Tanner 4/5) eller yngre än en tonåring (Tanner 1-Tanner 2/3) (återigen var visuella stimuli tagna från VPS).

I **studie IV** undersökte vi huruvida man i en dtRSVP kan fuska och uppvisa sådana responsmönster som gör det svårt att sanningsenligt bedöma försökspersonernas sexuella intresse. I denna studie ombads deltagarna att identifiera könet på de personer som presenterades och om dessa personer var nakna eller påklädda. En grupp heterosexuella män ombads fuska. Denna grupp informerades om den hypotetiska svarsstilen för heterosexuella och homosexuella män och ombads välja en homosexuell svarsstil.

I **studie V (SDS-studien)** instruerades deltagarna att betygsätta attraktiviteten, realismen och mognadsnivån hos våra datoriserade stimuli (studie

1), gradera mognadsgrad av samma stimuli (studie 2) och att betygsätta attraktiviteten, realismen och mognadsnivån av samma stimuli (studie 3).

När vi använde dtRSVP som mättningsförfarande för att skilja åt sexuell läggning i ett prov av homosexuella och heterosexuella män fann vi att sexuell relevanta stimuli påverkade informationsbehandling på ett förutsägbart sätt. Förfarandet hade en god förmåga att skilja sexuella preferenser mellan grupperna; verkliga sexuella preferenser modererade informationsbehandlingen av sexuella stimuli och förfarandet var svårt att påverka genom att fuska.

När vi använde dtRSVP som mättningsförfarande för att identifiera avvikande sexuell läggning bland dömda sexbrottslingar fann vi att de visade en annorlunda bearbetning av sexuella stimuli jämfört med andra deltagare och att dessa skillnader var de riktningar som förväntats. Dock fann vi att det var svårt att dra några slutsatser angående denna mätmetods förmåga att skilja mellan grupperna pedofiler och inte pedofiler. Slutligen fann vi att APS verkar vara ett användbart stimuluspaket för experimentell forskning om pedofilt sexuellt intressen.

## Abstract

Deviant Sexual Preference (DSP) has been found to be one of the most important predictors of sexual offence recidivism. Therefore, a valid and standardized tool for the assessment of DSP in legal decision-making and in the treatment of sex offenders would be useful. In the past decades, methods to assess DSP have been developed, but to overcome some of the limitations and problems with the available methods, recent research has focused on attentional methods.

The present thesis was part of a research project aiming to develop attentional methods for the assessment of DSP in male sexual offenders. More specifically, the aim of the thesis was to develop a dual-target Rapid Serial Visual Presentation (dtRSVP) procedure to identify DSP. We aimed at developing a procedure that exclusively would use pictures (males and females, nude and clothed) as stimuli in order to make the test applicable in different cultural contexts and for participants with different reading abilities.

In the dtRSVP, stimuli appear sequentially at the same spatial location. Each stimulus appears only during a small temporal slot (usually for a fraction of a second e.g., 100 ms), and participants are asked to identify two targets (items T1 and T2) and not to pay attention to the remaining distractor stimuli. In our dtRSVP measurement procedure, we measured two information-processing phenomena: The Attentional blink (AB) and the Pop Out effect (POE).

The AB refers to a phenomenon in which the identification of the T2 stimulus is impaired when it follows a T1 stimulus within approximately 500 ms in a dtRSVP. Regarding the AB phenomenon, we expected that the accuracy in the reporting of the second target (T2) would decrease when following accurately identified sexually preferred T1, compared to when following accurately identified non-sexually preferred T1.

The POE refers to a phenomenon that occurs in a visual search task (i.e., looking for a specific target in a complex visual scene) in which a unique visual

target (with a so called feature singleton) can be rapidly detected. The feature singleton provokes the stimulus to “pop out” from the background and this effect is larger if the stimulus also is emotionally relevant. Even if the original formulation of POE refers to a stimulus having a feature singleton in spatial tasks, we assumed that a similar phenomenon could be detected also in the dtRSVP task (that is a temporal task).

Thus, we evaluated the POE, expecting that the accuracy in the reporting of T1 and T2 would be relatively increased when T1 and T2 were sexually preferred by the participants, compared to when they were not (i.e., the accuracy in the reporting was expected to be higher when the target was more emotional in comparison to when it was less emotional).

In order to calibrate the procedures, we first conducted three studies investigating the possibility to differentiate homosexual men from heterosexual men and investigating the fakeability of the procedure measurement, before testing forensic populations of sex offenders. In addition, we created a new stimulus set for the assessment of pedophilic sexual interest that takes the ethical and legal concerns as far as possible into account and is largely standardized in order to maximize internal validity for the experimental work.

In **studies I, II, and IV**, we tested a total of 39 homosexual men and 39 heterosexual men. In **study III** we tested 69 male child sex offenders and 145 male controls. In **Studies I, II, III and IV**, participants were asked to identify two black-framed targets that had just been presented to them in a stream of 12 stimuli (two targets included) in a dtRSVP procedure.

In **Study I**, investigating if and how real-life sexual preference moderated information processing of sexually relevant photos, participants were asked to identify the gender of the individuals presented and if the individuals were nude or clothed. The visual stimuli were photos of men and women, nude and clothed.

In **Study II**, investigating if the dtRSVP can be used to differentiate sexual orientation in men, participants were asked to identify the gender of the individuals presented and whether the individual was adolescent/adult (Tanner

4/5) or prepubescent/pubescent (Tanner 1–Tanner 2/3). The visual stimuli were computer-generated images of nude and clothed individuals from the Virtual People Set (VPS).

In **Study III**, investigating if the dtRSVP can be used to identify deviant sexual interest in men, participants were asked to identify the gender of the individuals presented and whether the individual was an adolescent/adult (Tanner 4/5) or prepubescent/pubescent (Tanner 1–Tanner 2/3). The visual stimuli were from the VPS.

In **Study IV**, investigating the fakeability of the dtRSVP when used as an attention-based measurement procedure of sexual preference, participants were asked to identify the gender of the individuals presented and if the individuals were nude or clothed. The visual stimuli were photos of men and women, nude and clothed. The fakers, who were heterosexual, were informed about the hypothesized response style of heterosexual men and homosexual men and were asked to adopt a homosexual response style.

**Study V (SDS-Study).** This study consisted of three sub studies. In SDS-Study 1, participants were 20 (10 female, 10 male), in SDS-Study 2, participants were 110 (55 males, 55 female), in SDS-Study 3, 106 male participants took part in the study. 59 men were sampled from the community (community sample) and 47 individuals were inmates convicted either for a hands-on child sexual abuse offense or for the possession or distribution of child pornography. In **this study** participants were instructed to rate attractiveness, realism and the maturity level of the stimuli (study 1), to rate the maturity level of the stimuli (study 2), to rate the attractiveness, realism and the maturity level of the stimuli (study 3).

The findings of **Study I** and **Study II** showed that using photos of men and women as stimuli in a dtRSVP allowed the identification of the participants' sexual preference (homosexual men vs. heterosexual men). The findings of **Study II** showed that dtRSVP can be used to assess sexual preference (homosexual men vs. heterosexual men) using images from the VPS. In **Study**



**III**, we found differences in response style in the expected direction between groups (Child Sex Offenders, Others Sex Offenders, Non Sex Offenders and Community Control). However, it was not possible to reach an optimal trade-off between the proportion of participants whose sexual preference was correctly predicted (pedophile vs. non-pedophile) and the proportion of participants whose sexual preference was falsely predicted. The findings of **Study IV** showed that the procedure was resistant to faking. The **SDS-Study** yielded good-to-high estimates of observer agreement with regard to stimulus maturity levels by two methods (study 1, 2) and study 3 extended these findings with regard to judgments made by convicted child sexual offenders.

When we used dtRSVP as an attention-based measurement procedure to differentiate sexual preference in a sample of homosexual men and heterosexual men we found that sexually preferred stimuli affected the information processing in a predictable way and that the procedure had a good capacity to differentiate sexual preference between the groups; real-life sexual preference moderated the detection rates of sexual stimuli; and that the procedure had a moderate resilience to faking.

When we used dtRSVP as an attention-based measurement procedure to identify deviant sexual preference in a forensic population, we found that pedophilic participants showed different styles in processing of sexual stimuli in comparison to non-pedophilic participants and these differences were in the expected directions.

However, we found that it was difficult to reach any conclusions on this measurement procedure's ability to differentiate between the groups (pedophile vs. non-pedophile). Finally, we found that VPS appears to be a potentially useful stimulus set for experimental research into pedophilic sexual interest.

## Abbreviations

AB	<p>Attentional Blink</p> <p>In the dtRSVP, when observers attempt to detect two targets (T1 and T2) in a stream of stimuli presented in rapid succession, identification of T2 is impaired when it follows T1 within approximately 500 ms.</p>
DSP	<p>Deviant Sexual Preference</p> <p>DSP refers to a relative attentional preference for a prepubescent target over another post pubescent target.</p>
dtRSVP	<p>dual-target Rapid Serial Visual Presentation</p> <p>In dtRSVP, an array of stimuli appears sequentially at the same spatial location, for a small temporal slot and participants are asked to report two target items and not to pay any attention to the remaining distractor stimuli.</p>
PPG	<p>Penile plethysmography</p> <p>PPG is the measurement of blood flow to the penis. PPG is largely used to determine the level of sexual arousal as the participant is exposed to sexually suggestive content, such as pictures, audio or movies audio.</p>
POE	<p>Pop Out Effect</p> <p>POE refers to a phenomenon that occurs in visual search tasks in which a unique visual target (e.g., a feature singleton) can be rapidly detected in a set of homogeneous distractors.</p>
SDS-Study	<p>Stimuli Development Study</p> <p>A study aimed to create a new stimulus set for the assessment of pedophilic sexual interest that takes the ethical and legal concerns as far as possible into account and is largely standardized in order to maximize internal validity for the experimental work.</p>
VPS	<p>Virtual People Set</p> <p>The VPS contains 108 picture computer generated images depicting males and females, nude and clothed, at different Tanners stages. The validity of the VPS stimuli was tested in the SDS-Study.</p>

# 1 Introduction

## 1.1 Definition of deviant sexual preference (DSP)

There is a general consensus that complex processes govern human behavior. The genesis of thoughts and emotions are the result of many elements (both internal and external) and, therefore, it is unlikely that one-factor explanations of any specific human conduct will be fruitful. However, during the adventure “to find a satisfactory explanation of all that affects us” (Popper, 1959), a researcher sometimes finds a single element that, compared to other elements, plays a more important role in explaining the phenomenon under investigation. This could be considered true in predicting recidivism among sex offenders who have offended against children (Ward et al., 2005). While no single risk factor that is both necessary and sufficient has been identified so far, several studies have found that an ongoing sexual preference for children plays a remarkably important role in predicting recidivism.

In the present study, an ongoing sexual preference for children is considered a deviant sexual preference (DSP) and refers to a pattern of symptoms or behaviors that meet the diagnostic criteria for Pedophilic Disorder in the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) (American Psychiatric Association, 2013).

The diagnostic criteria for Pedophilic Disorder in DSM V are:

- A) Over a period of at least 6 months, recurrent, intense sexually arousing fantasies, sexual urges, or behavior involving sexual activity with a prepubescent child or children (generally age 13 or younger).
- B) The individual has acted on these sexual urges, or the sexual urges or fantasies cause marked distress or interpersonal difficulty.
- C) The individual is at least age 16 years and at least 5 years older than the child or children in Criterion A.

Note: Do not include an individual in late adolescence involved in an ongoing sexual relationship with a 12 or 13-year-old.

In the 10<sup>th</sup> International Classification of Mental and Behavioral Disorders (ICD 10, World Health Organization, 2010) Sexual Deviant Interest is defined as “recurrent sexual urges and fantasies involving unusual objects or activities; the

individual either acts on the urges or is markedly distressed by them; the preference has been present for at least 6 months.”

### *DSP and sexual offence recidivism*

Several studies have found a relation between DSP and sexual offence recidivism. Launay (1994) found that sexual preference for children as measured by phallometric testing was the single strongest predictor of sex offence recidivism. Harris, Rice, Quinsey, and Chaplin (1996) found that sex offenders against children showed significantly greater sexual preference in children compared to men who had not molested children. Hanson and Bussière (1998), in a meta-analysis, found that phallometrically measured DSP was the single strongest predictor of sexual offence recidivism. Hanson and Morton-Bourgon (2004, 2009) found that sexual interest<sup>1</sup> in children was one of the best predictors of sexual recidivism among sex offenders against children and that DSP and sexual preoccupation are among the most important targets in the treatment of sex offenders in order to reduce recidivism.

Looman and Abracen (2010), in a comparison of measures of risk for recidivism scales in sex offenders (Static-99, Risk Matrix 2000, Rapid Risk Assessment for Sex Offence Recidivism and Static-2002), found that only the deviant sexual interest subscale among the child molesters (all from the Static-2002 scale) was predictive of sexual reoffending among child molesters.

Therefore, considering the fact that DSP has been shown to be a crucial factor in sex offending (Thornton, 2002) as well as the strongest predictor of sex offence recidivism, it would be useful to have a valid and reliable diagnostic tool for the assessment of DSP. Such an assessment tool would be useful in both legal decision-making and in evaluating treatment outcomes for sex offenders.

---

<sup>1</sup> In the present thesis, we use the term ‘sexual preference’ instead of ‘sexual interest’. We use the term ‘sexual interest’ only when we cite a study that used this term.

## 1.2 The pathways of sexual arousal

According to Pfaus (2007), it is clear that a model of sexual arousal has to include neurobiological findings (Ågmo & Ellingsen, 2003; Everitt & Bancroft, 1991; Pfaus, Kippin, & Coria-Avila, 2003), incentive motivation theories (Berridge & Robinson, 1998; Stewart, 1995; Toates, 1992), information processing models (Everaerd, 1995), and an evolutionary understanding of human behavior (Abramson & Pinkerton, 1995; Buss, 1994; Symons, 1979). For the purposes of the present thesis I report a few models of sexual arousal in order to facilitate the understanding of how DSP in men can be identified with attention-based measures.

Singer (1984) sketched a model of sexual arousal and attraction divided into three sequential components (Singer, 1984). The first component is the aesthetic response, which is a bias towards noticing an attractive face or figure, leading to an increased attention towards the object of attraction. This increased attention typically includes eye and head movements toward the object. The second component is the approach response that is a consequence of the aesthetic response. In the approach response the individual attempts to move closer to the object of interest. If the desired object is attended to and is physically close, a genital response occurs in the third and final stage. Pfaus (1996) has postulated the Incentive Sequence Model of sexual behavior. This model is conceptually similar to Singer's (1984) model and consists of three, partly overlapping phases that occur sequentially: an appetitive phase (which comprises sexual desire including sexual fantasies, sexual excitement and preparatory behaviors), a precopulatory phase (which comprises arousal, foreplay, solicitation) and a consummatory phase (copulation/masturbation and orgasm).

Bancroft (2002) analyzed sexual arousal from four different perspectives: 1) information processing of sexual stimuli; 2) central arousal; (3) the genital response, and (4) behavior. Information processing consists of the assessment and processing of sexual stimuli (external, such as visual or auditory stimuli, or internal, such as thoughts). This process can be 'automatic' and unconscious or

‘controlled’ and conscious (Janssen et al. 2000). Central arousal refers to the activation of emotional states involving cortical activity and peripheral autonomic receptiveness affecting peripheral mechanisms such as blood pressure. Genital response consists of the physiological changes of the genital organs in order to prepare and perform the reproductive sequence. Finally, behavior describes the pattern of actions in order to get access to the partner and engage in coitus (or in the case of a receptive partner not being available, masturbating).

Both, Everaerd and Laan (2007) described a model of sexual motivation where excitement precedes sexual desire. According to this model, sexual motivation begins with the processing of a sexually salient stimulus (actually present or imagined). This automatically activates emotional systems and causes physical changes predisposed for sexual activities. These changes include motor responses involved in sex-specific responses and motor responses involved in general approach behavior. The awareness of physical changes causes sexual excitement in a feedback loop process. Both and colleagues (2007, p. 331) underlined that “without a stimulus that activates arousal, there will be no desire”.

Toates (2009) proposed an integrative theoretical framework for understanding sexual motivation, arousal, and behavior, combining the principles of incentive motivation theory and the hierarchical control of behavior. This model focuses on external stimuli and on cognitive representations of incentives and the associations between them. Sexual motivation rises through the attractiveness of possible rewards in the environment.

Reviewing the above models, it becomes clear that most models of sexual arousal and/or sexual attraction assume a process that begins with the incoming of a sexual stimulus (external, such as seeing an attractive object, or internal, such as thoughts or fantasies). The information processing of the stimulus activates emotional systems causing physical changes predisposing the

individual for sexual activities. The information processing involved in sexual arousal and sexual attraction is an attractive target for measurements of sexual preferences. This is because the information processes are believed to be, at least partly, beyond cognitive control. To target DSP and distinguish DSP from non-DSP, a measurement targeting the information process should administer different types of sexual stimuli (normal and deviant) to the participants, and assess to which types of stimuli the participants show signs of sexual arousal. According to this idea, DSP can then be investigated by measuring the physical changes of the appetitive phase (such as the startle eye-blink, dilation of pupil), or measuring the physical changes of the precopulative/genital response phase (such as increased blood flow to the penis) during the viewing of sexual stimuli. Moreover, sexual arousal can be directly measured through psychometric self-report or clinical interview evaluating the responses given by the participant to direct questions regarding DSP, or indirectly measured through a variety of methods analyzing the patterns of information processing of sexual stimuli (see Kalmus & Beech [2005] for an overview).

### 1.3 Non-physiological methods of assessing DSP

Several psychometric tools are available for the assessment of sexual offenders and child molesters. These include, for example, Sexual Interest Card Sort Questionnaire (Abel & Becker, 1979; Multiphasic Sex Inventory [MS I] (Nichols & Molinder, 1984); MSI-II (Nichols & Molinder, 2000); the Multidimensional Inventory of Development, Sex, and Aggression, (MIDSA; Knight, Prentky, & Cerce, 1994) and personality traits associated with sexual offending (Minnesota Multiphasic Personality Inventory, MMPI; Kalichman, Szymanowski, McKee, Taylor, & Craig, 1989) (for a full review, see Akerman & Beech, 2011 or Hanson, Cox, & Woszcyna, 1991). The most commonly used methods include measures of attitudes towards women, attitudes towards sexual offending, personality measures, and measures of general psychopathology. Even if some differences among offenders and non-offenders have been reported

(Quinsey, 1984; Walker, Rowe, see Drieschner & Lange, 1999, for an overview), one problem is the obvious risk for faking in self-reports of attitudes (Quinsey et al., 1998; cf. Stermac, Segal & Gillis, 1990). Seto (2008, p. 477) concluded that, even if self-reports represent a potential source of information, problematic issues like recall bias remain unresolved. Moreover, in forensic settings, self-reports are prone to faking because the participants have obvious interests to present themselves in a socially desirable way. Similarly, clinical interviews collect information regarding what a participant is willing to say or has the ability to say (i.e., if he suffers some memory loss or cognitive impairment). Therefore, the clinical interviews suffer from subjectivity of the interviewer in interpreting the interviewee's responses and from the possibly decreased willingness or ability of the interviewee to disclose thoughts and emotions.

However, it should be noted that the disadvantages of clinical interview and self-report only apply to adversarial circumstances like forensic evaluation for the determination of guilt or for civil commitment trials. In non-adversarial conditions when compared to PPG, self-report has often been found to provide greater group differentiation (Seto, Lalumière, Harris, & Chivers, 2012; Stinson & Becker, 2008; Laws, Hanson, Osborn, & Greenbaum, 2000; Day, Miner, Sturgeon, & Murphy, 1989).

#### 1.4 Physiological methods of assessing DSP

These methods can be divided into: 1) polygraphy, which does not identify sexual preference or sexual arousal directly but rather the veracity of the participants' accounts regarding their thoughts and emotions as a response to direct questions regarding DSP; 2) several procedures and tools that directly assess participants' responses to sexual stimuli (the first stage of the model postulated by Singer that correspond to the appetitive phase of the sexual arousing of the Pfaus's Incentive Sequence Model) or assess participants' genital response in reaction to sexual stimuli (visual or audio) (the third stage of the



model postulated by Singer that correspond to the precopulatory phase of the sexual arousing of the Pfaus's Incentive Sequence Model).

Polygraphy suffers from fakeability and from the fact that the veracity of the responses cannot always be assessed because there is often no evidence of what is the actual truth (for example has the respondent had a deviant sexual fantasy or thought, and has he been sexually aroused by these) (Akerman & Beech, 2012). Because this method is not often used to assess sexual preferences, it will not be discussed further in the present work.

There are also several tools and procedures that measure physiological parameters related to the aesthetic and genital responses (see Kalmus & Beech, 2005). They all aim at assessing a participant's automatic responses.

#### 1.4.1 Measuring genital response

We are focusing our attention on the pattern of the sexual arousal in men because men are more likely than women to be sexually interested in children (Smiljanich & Briere, 1996) (in Seto 2008, p. 6, 7)<sup>2</sup>.

Genital response consists of the physiological changes of the genital organs in order to prepare and perform the reproductive sequence.

The assumption of the physiological methods of measurement of genital response is that the penile response is an indicator of sexual arousal (stage 3 of Singer's model/the Precopulatory phase of sexual arousal of the Pfaus's Incentive Sequence Model). Therefore, based on the association between sexual stimuli (normal vs. deviant) and penile response, it's possible to infer the participant's sexual preferences (normal vs. deviant). The physical changes that can be measured (e.g., volume and circumference of the penis), are the effects of the penile tumescence (Penile Plethysmography, PPG) usually in response to visual stimuli (Kalmus & Beech, 2003).

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<sup>2</sup> There is little empirical data on the incidence of sexual preference in children. The prevalence of pedophilia is most likely below 5% (Seto, 2008, pp.6-7). The estimated lifetime prevalence of pedophilia among men in the general population is under 1% (Ahlers et al., 2011).

In their meta-analysis of predictors of sexual recidivism, Hanson and Bussière (1998) identified DSP, measured by PPG, as the single strongest factor in sexual offence recidivism. DSP was related to sexual recidivism in the entire sample (rapists and sex offenders against children), but the predictive accuracy was stronger among the latter group (Hanson & Bussière, 1998).

PPG measurements have been used empirically to study child molesters, and the aim of these studies has been to measure how the sexual interests of offenders differ from the interests of a control group. Three studies have evaluated phallometric sensitivity and specificity<sup>3</sup> for diagnosing pedophilia (Blanchard, Klassen, Dickey, Kuban, & Blak, 2001; Freund & Blanchard, 1989; Freund & Watson, 1991) (in Laws & Donahue, 2008, pag. 188-189). These studies found high level of specificity and medium and low level of sensitivity<sup>4</sup>.

Even if PPG "(...) has, for the most part, proven to be an excellent technology for assessing sexual interest" (Gress, Laws, pag. 109) and even if PPG has obtained recognition for its capacity to identify DSP and differentiate sexual offenders from non-deviant individuals (Abel, Blanchard, & Barlow, 1981; Avery-Clark & Laws, 1984; Barsetti, Earls, Lalumière, & Bélanger, 1998; Becker, Stein, Kaplan, & Cunningham-Rathner, 1992; Howes, 1998; Lalumière & Quinsey, 1994; Malcolm, Andrews, & Quinsey, 1993; Quinsey & Chaplin, 1988a; Serin, Malcolm, Khanna, & Barbaree, 1994) some important challenges remain regarding the use of PPG.

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<sup>3</sup> Sensitivity was calculated by dividing the number of participants identified by the phallometric assessment as pedophiles out of the total number of true pedophiles in the sample. Specificity was calculated by dividing the number of teleiophilic participants (i.e., men who prefer adult women, (Blanchard et al. 2000) identified as non-pedophile from the total number of true teleiophilic in the sample (in Laws and Donahue, pag. 188-189).

<sup>4</sup> Regarding specificity, findings have shown a range from 80% to 96.9%. Regarding sensitivity, for child molesters who had multiple child victims, the values varied from 61% to 88.6%. Similar findings were found among adolescents who sexually offended against children (specificity was 92%), even if sensitivity was lower (42%) (Seto et al., 2000).

PPG suffers from intrusiveness and not all participants have a sufficient penile response during the procedure<sup>5</sup>. Another problem in PPG assessments is faking both through voluntary suppression and expression of penile arousal<sup>6</sup>. Furthermore, it has been found that use of alcohol and/or drugs can have an effect on sexual functioning and erectile response, consequently these dysfunctions could influence the genital response during a PPG (Thornton, Finch, & Goeser 2007). Regarding discriminative validity, it was found that plethysmographic comparisons of child-sex offenders to non-offenders produced significant differences (Barbaree & Marshall, 1989; Freund, 1965; Quinsey & Chaplin, 1988; Quinsey, Chaplin, & Carrigan, 1979), however, there often remains a large proportion of wrongly classified participants (Mc Conaghy, 1999).

Finally, Seto (2008, p. 35) observed that phallometric testing suffers from lack of standardization in procedures, stimuli, and data analysis<sup>7</sup>.

#### 1.4.2 Measuring the aesthetic response

As earlier described, the first stage of sexual arousal is an emotional reaction to noticing an attractive face or figure, leading to an increased attention towards the object of attraction. This increased attention typically includes eye and head movements toward the object. To assess this stage, measuring the startle eye-blink response and eye tracking has shown promising results.

The basic idea in the field of assessing DSP is that participants will show a diminished startle reaction if they attend an image they find sexually attractive. Although the first findings are quite promising (Janssen, Vorst, Finn, &

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<sup>5</sup> In published studies, between 20% and 75% of participants have been low responders, which mean that they obtained less than 10-20% of a full erection (Looman et al., 1998).

<sup>6</sup> Renaud et al. (2009), Golde, Strassberg, & Turner (2000) and Howes (1998) reported that a large number of participants (up to 80%) were able to suppress their penile response. Further, according to a review by Kalmus and Beech (2005), many studies have excluded low responders, reducing generalizability of the assessments. Investigating the fakeability of the PPG test, moreover, Renaud et al. (2010) declared that PPG failed to discriminate between sexual preferences and is easily faked.

<sup>7</sup> Regarding the standardization issue, see a recent attempt of standardization of Penile Plethysmography testing in assessment of problematic sexual interests (Murphy et. al, 2015).

Bancroft, 2002; Hecker, King, & Scoular, 2006; Hecker, King, & Scoular, 2009), further research is necessary. Bradley, Moulder, and Lang (2005) have found that anticipatory anxiety causes a large startle response, which may be problematic and confound results in these types of studies.

Eye tracking refers to the process of measuring either where the gaze is directed or the motion of the eye relative to the head. The basic idea in the field of assessing DSP is that the gaze moves automatically towards sexually preferred stimuli and the participants explore stimuli differently depending on whether the stimuli are sexually preferred or if they are not. It has recently been shown that eye tracking provides useful information in identifying DSP (Hall, Hogue & Guo, 2014; Hogue & Houge et al., 2010; Renaud, Goyette, Chartier, Zhornicki, Trottier, & Rouleau, 2010) However, this method is not immune to faking because it has been shown that eye-movements could be faked once participants knew what was being measured (Akerman & Beech, 2012).

### 1.5 Attention-based measurement procedure to assess sexual preferences: a new generation of procedures to assess DSP

In order to overcome the critical points mentioned above, a new generation of procedures has been developed in the last decade. Attentional methods of assessing sexual preference are thought to provide estimates of non-observable psychological constructs considered important to treatment and risk assessments. They are also believed less susceptible to willful manipulation (Gress & Laws, 2009). These methods have the attributes that Thornton and Laws (2009) describe as important characteristics of a diagnostic tool measuring sexual preferences: they are easy to implement, portable and easy to use in any setting, relatively inexpensive, difficult to fake, easy to score and interpret, not physically intrusive, and usable for males and females of any age and open to psychometric evaluation.

### *Theoretical background*

Attention-based measurement procedure, used to assess sexual preference, works through discriminating between the relatively increased and the relatively decreased attention directed towards highly sexually relevant (hereafter, sexually relevant) or less sexually relevant (hereafter, sexual irrelevant) stimuli. This attention is often measured through performance in simple information processing tasks presented simultaneously, prior, or, after a sexually relevant or irrelevant stimulus. The ability to identify sexual preference is thought to stem from variations in information-processing capacity due to simultaneous processing of stimuli that are either relevant or irrelevant according to the individual's sexual preference (Kalmus & Beech, 2005).

Attentional measures of DSP are thus based on an information-processing model to human sexuality (Geer, Lapour, & Jackson, 1993; Everaerd, 1995). Such information-processing models commonly suggest that the processing of sexually significant stimuli initially occurs at a pre-attentive level (Spiering & Everaerd, 2007), where attention is automatically drawn to the stimulus. This conceptual model makes a distinction between automatic (unconscious or pre-attentive) and controlled processing of sexual stimuli. Attentional based measures of DSP rely on the following findings: 1) The first stage of sexual arousal can be thought of as an attention-increasing phase much like an emotion, and it has been hypothesized and empirically supported that this process is pre-attentive and automatic (Hietanen & Nummenmaa, 2011; Jiang, Costello, Fang, Huang, & He, 2006; Schupp, Junghöfer, Weike, & Hamm, 2003). 2) Salient stimuli capture attention, leading to better performance and more accurate reporting for affectively arousing vs. non-arousing stimuli (Vuilleumier, 2005). 3) Sexually salient stimuli may lead to a conscious allocation of cognitive resources that would interfere with the performance in other simultaneous tasks (see Kahneman, 1973). 4) There is a hesitancy decision-making related to erotic material (Sexual Content induced Delay, SCID: Geer & Bellard, 1996; Geer & Melton, 1997).

Several procedures using attentional methods and implicit association have been developed to identify deviant sexual preference in men: the Choice Reaction Time (CRT) (Giotakos, 2005; Gress, 2008; Mokros, Dombert, Osterheider, Zappalà, Santtila, 2009; Santtila, Mokros, Koivisto, Sandnabba, Zappalà, & Osterheider, 2009), the Viewing Time (VT) (Abel et al., 2004; Glasgow, Osborne, & Croxen, 2003; Gress, 2005; Harris, Rice, Quinsey, & Chaplin, 1996), the Implicit Association Test (IAT) (Banse, Schmidt, & Clarbour, 2010; Brown, Gray, & Snowden, 2009; Gray, Brown, MacCulloch, Smith, & Snowden, 2005; Mihailides, Devilly, & Ward, 2004; Nunes, Firestone, & Baldwin, 2007; Ó Ciardha & Gormley, 2009; Steffens, Yundina, & Panning, 2008; Snowden, Wichter, & Gray, 2008), the Pictorial Modified Stroop task (P-MST)(Ó Ciardha & Gormley, 2012, 2013), the Emotional Stroop Task (Smith, Watermann, 2004; Price, Hanson, 2007; Price, Beech, Mitchell, & Humphreys, 2013) and the dtRSVP (Beech, Kalmus, Tipper, Baudouin, Flak, & Humphreys, 2008).

The idea of CRT is to measure the sexual preference of an individual by asking this individual to identify the position of a dot superimposed on a picture of a person. Pedophilic participants are expected to show increased reaction times in the cognitive task when the dot is superimposed on child stimuli whereas non-pedophilic participants are expected to show the same effect when adult stimuli are used. The underlying assumption is that this method can distinguish the increased allocation of attention upon other information-processing tasks. Sexual preference is thus inferred from increased attention causing a delay in a simple information-processing task. Given a match between the nature of the stimulus and personal sexual preference, the delay is assumed to occur because interest in the sexual stimulus inhibits the performance in other cognitive tasks.

Viewing time is based on the simple idea that participants look longer at sexually preferred stimuli. Therefore, it is expected that the pedophilic participants look longer at the stimuli depicting prepubescent subjects than

stimuli depicting adult subjects whereas the reverse is expected for non-pedophilic participants. In this task, participants are asked to rate the sexual attractiveness of the stimuli (varying in terms of gender and different age groups). Besides this direct measurement (i.e., explicit rating of the stimuli), the inspection time of each stimulus is covertly recorded, averaged for each target category, and used as an indirect indicator of sexual preference.

IAT provides a measure of the strengths between automatic associations. This measure is calculated from performance speeds in two classification tasks in which association strengths influence performance. In this task, reaction times to concept pairs that the participant may hold as congruous are compared with reaction times to concept pairs that the participant may hold as incongruous. The use of IAT as a measurement procedure of sexual preference relies on the assumption that certain categories are more strongly associated with the concept of sex than others. Therefore, pedophilic participants are expected to have faster reaction times when the concepts of child and sex are paired in comparison to when adult and sex are paired.

In the P-MST task, participants are asked to, as quickly as possible, identify the color in which a stimulus is presented. A systematic decrease of time of response for a particular stimulus category is interpreted as an attentional bias towards that category. The use of P-MST task as measurement procedure of sexual preference relies on the expectation that a participant produce a delay in responding to categories related to their sexual preference.

The Emotional Stroop Task is used as an information-processing approach to evaluate emotions. This procedure works by examining the response time of the participants to name the color of neutral and emotion-inducing words intended to reflect sexual interests more specific to sexual abusers.

All these attentional methods are based on measuring variation in reaction time or processing time. Reaction time is presumably not very resistant to faking and there is a lot of within-individual variation and between-individual variation that may cause the decrease in reliability of RT (Jensen, 1992).

In this present thesis we investigated the possibility to develop a measurement procedure of DSP using the dtRSVP procedure that could also be more resistant to faking than earlier attention based methods.

In our studies we use sexual preference to refer to relative sexual preference for one object over another, operationalized as an attentional preference for one target category over another target category (i.e., adult male vs. adult female). In light of that, DSP refers to a relative attentional preference for a prepubescent target over another post pubescent target.

## 1.6 Rapid Serial Visual Presentation procedure

Rapid Serial Visual Presentation (RSVP) was not originally developed as a procedure to assess DSP but to study memory, attention, and perception. In RSVP, an array of stimuli is presented sequentially at the same spatial location. Each stimuli appear during a short time frame (usually for a fraction of a second e.g., 100 ms), and participants are asked either to report all the stimuli presented (full report) or to report only target item(s) and to not pay attention to the remaining distractor stimuli (partial report). If the participants are instructed to report just one target item the procedure is called single target Rapid Serial Visual Presentation, and if they are instructed to report two targets the procedure is called dual-target Rapid Serial Visual Presentation (dtRSVP). The underlying fundamental principle of the RSVP paradigm is that, due to the limits on temporal processing imposed by the procedure, researchers are able to evaluate the rate at which information is perceived, analyzed, and encoded by the participants (Chun & Wolfe, 2001; Coltheart, 1999). In the array of stimuli, researchers insert target stimuli (usually indicated as T1 and T2) between distractor stimuli. T1 precedes T2 in the sequence of stimuli. The presentation time of each stimulus usually varies from 50 ms to 180 ms and each stimulus can be followed by a blank picture (20ms - 70ms). T1 and T2 differ from the distractor stimuli regarding perceptual features (e.g., two red digits between white digits), semantic features (e.g., two letters between digits) or a

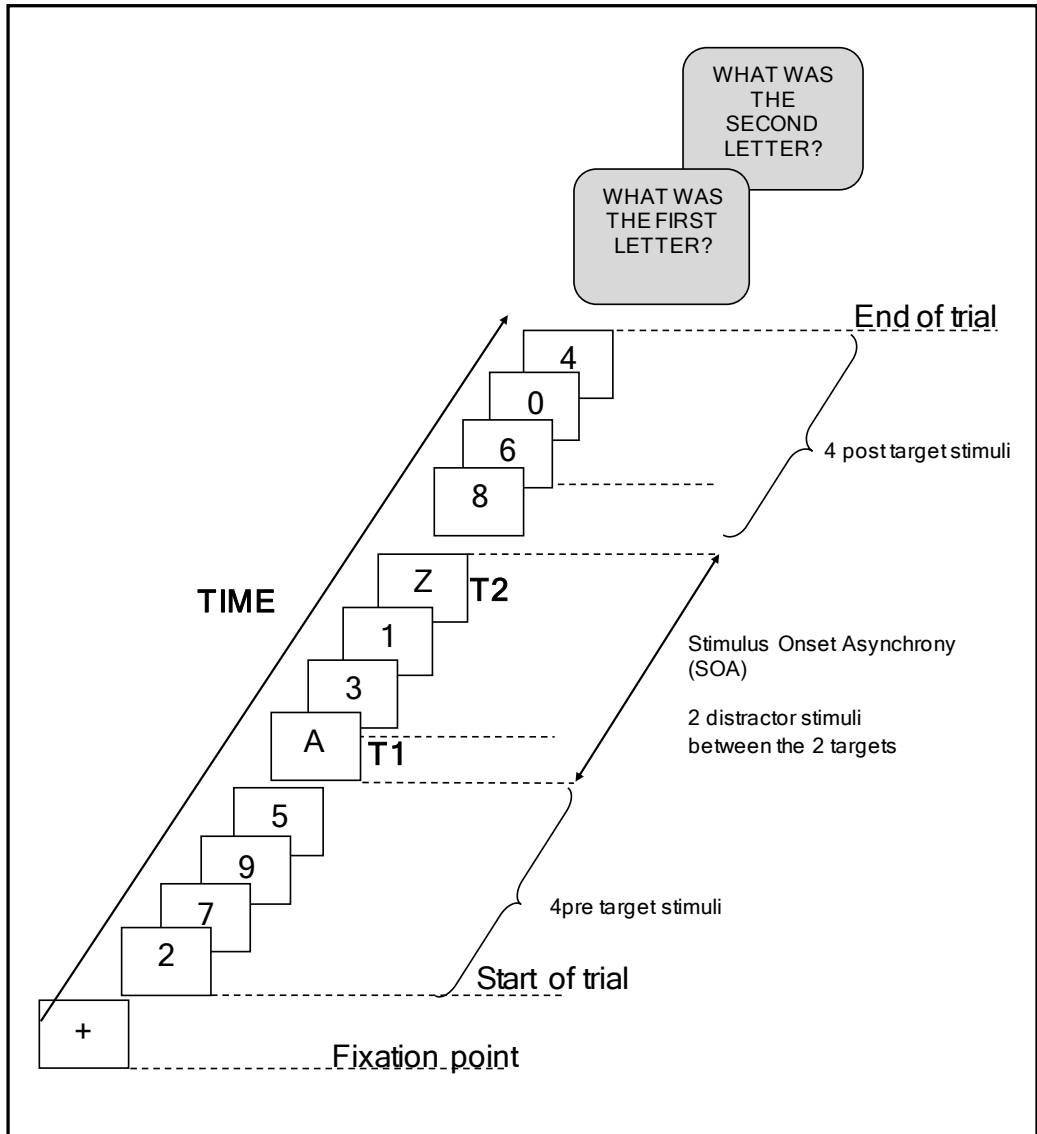


combination (e.g., two red letters between white digits). Each RSVP trial (i.e., each isolated presentation of a sequence of stimuli) starts with a fixation point (e.g., a fixation cross usually presented for 1000 ms in the center of the display) that inform the participant that the sequence of stimuli is incoming. The fixation cross is followed by a rapid serial presentation of the stimuli. After the stimuli are presented, participants are required to report T2 and to ignore T1 (if the procedure is a single target Rapid Serial Visual Presentation) or to report both T1 and T2 (if the procedure is a dual-target Rapid Serial Visual Presentation). Participants use the computer's keyboard to make their choices. The participants are not put under time pressure when making their choices and researchers do not usually measure the reaction times. If unsure, participants are asked to make their best guess. After each response, another trial starts after about 1000ms.

Most often, the main experimental manipulation in a RSVP procedure consists in the variation of the time interval between the presentation of T1 and T2 (stimulus onset asynchrony, SOA)<sup>8</sup> and in varying the number of distractor stimuli. The position of T2 with respect to T1 is indicated with the term 'lag'. So, for example, if the researcher has inserted two distractors between T1 and T2, this is described as lag 3, because T2 appears as the third stimulus after T1 (Figure 1).

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<sup>8</sup>An alternative way to indicate this value is the term 'Interstimulus Interval' (ISI).



*Figure 1.* A schematic overview of the dual-target Rapid Serial Visual Presentation procedure lag 3 trial (because T2 appears after two distractor stimuli). In this task, participants are required to identify two letters (T1 and T2) among digit distractors and report them at the end of the stream.

It should be mentioned that the original experiments where pictures were presented tachistoscopically were ideated and conducted before the personal computer was a readily available household item. Nowadays, researchers use computers and easy-to-obtain software to set up RSVP procedures. The first researchers (Potter & Levy, 1969) who studied recognition memory for a rapid sequence of pictures used Kodachrome movie film and variable-speed 16 mm movie projector with a 750-w bulb to project the films on a lenticular screen distant about 3 meters. Eriksen and Spencer (1969) used of a 10-channel tachistoscope to present successively single elements at varying rates.

#### 1.6.1 The Attentional Blink phenomenon

##### *The rise of the Attentional Blink*

Broadbent and Broadbent (1987) were the first to report a decrease in accuracy in the reporting of T2 when they presented participants with RSVP<sup>9</sup> streams of words containing two targets defined by either category or letter case (in Dux, Marois, 2009)<sup>10</sup>. In an experiment where the participants were presented with RSVP streams of digits at the rate of 100 ms/item, and their task was to report an outlined digit (T1), it was found that the participants usually reported T1, the subsequent item, and the items that were shown 400ms after T1 (i.e., participants usually did not report the third and the fourth stimulus). In four experiments Raymond, Shapiro and Arnell (1992) explored whether the causes of the post-target processing deficit, are either attentional (i.e., due to a limit of cognitive resources) or sensory (i.e., due to characteristics of the perception system). In these experiments, RSVP arrays of black letter stimuli were shown at the rate of 100 ms, and participants were required to name the T1 stimulus (a single white letter) and detect the presence or absence of letter “X” (T2). While

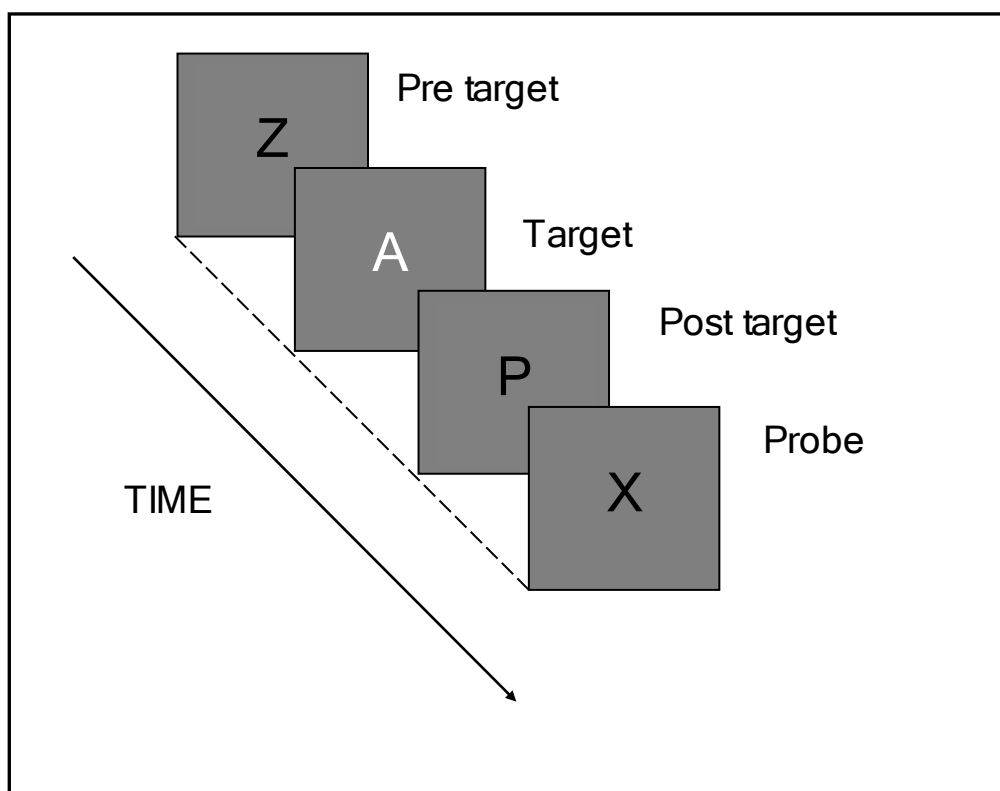
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<sup>9</sup> In Broadbent and Broadbent, a series of items was presented sequentially in the same location and the participants were asked to react only to a specified target item (Eriksen & Spencer, 1969).

<sup>10</sup> Broadbent and Broadbent extended Lawrence's (1971) study by requiring participants to report two uppercase words embedded among lowercase words, with the lag between the two targets varied.

T1 targets were correctly identified, the T2 probes were poorly detected when they were presented during a 270 ms interval beginning 180 ms after the target. T2 probes shown immediately after the target or later in the RSVP stream were correctly detected (see Figure 2). Researchers found that the temporary reduction in probe detection was not found in conditions in which a short blank interval followed the target or in which participants were not asked to identify the target.

Considering the results of the four experiments, Raymond and colleagues (1992) stated that the findings could be explained as an Attentional Blink (AB). From this study onwards, the phenomenon in which the identification of the T2 stimulus is impaired when it follows a T1 stimulus within approximately 500 ms in a dtRSVP has been called Attentional Blink<sup>11</sup> (Figure 2).



*Figure 2.* In a single task rapid serial visual presentation, participants were required to detect the presence or absence of a letter (probe). The target was a white letter. Whereas the targets were accurately detected the probes were poorly detected when they were shown during a 270 ms interval beginning 180 ms after the target.

### *Theoretical Accounts of the Attentional Blink*

In the last twenty years, several models have been developed to explain AB (see two recent reviews for the taxonomy of the models of the AB, Martens, & Wyble, 2010 and Dux & Marois, 2009). Undoubtedly, limited processing resources are an important factor in generating AB. However, AB is not a unitary phenomenon, and multiple factors working independently from one another cause an AB (Kawahara, 2003; Kawara et al., 2006). Recently, Lagroix, Spalek, Wyble, Jannati, and Di Lollo (2012) suggested a taxonomy of theoretical conceptual accounts of the AB designed to distinguish between two classes of theory: T1 based and distractor based. According to the T1 based theories, T1 processing alone is sufficient to cause the AB. In distractor-based theories the requirement to process T1 is not sufficient to cause the AB and the presence of at least one distractor following T1 is regarded as necessary. The findings of Lagroix et al. (2012) disconfirmed predictions from distractor-based theories and support the claim that T1 processing alone is sufficient for the occurrence of the AB. Therefore, we present only the T1 based models of AB here<sup>12</sup>.

*Two stage model.* Chun and Potter (1995) suggested that AB is caused by a limited capacity in a Stage 1. This stage involves the processing and consolidation of the target (T1) after the target (T1) has been initially detected. According to the two-stage model, stimuli are quickly processed in Stage 2 in order to search relevant characteristics for target detection (e.g., color) to make a selection of candidate targets. At this stage, the representations are volatile and subject to rapid decay and overwriting by the following stimuli unless they are selected for further processing to permit their consolidation. Stage 2 begins after Stage 1 target detection by a transient attentional response that leads to the target being encoded in working memory. If T2 appears before Stage 2 is completed, it

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<sup>12</sup> It should be noted that we have not mentioned here others several models were developed in order to explain AB phenomenon For example the set of Hybrid Models, the Gated auto-associator model, the corollary discharge of attention movement model, the global workspace model, the Episodic simultaneous type/serial token model, the boost and bounce model, the interference model, the temporary loss of control model, the threaded cognition model, the attention cascade model (see Dux, Marois, 2009).

will be “Stage 1 processed” but its entrance into Stage 2 will be delayed and consequently the probability that T2 will be lost is increased (because in Stage 1 the representations are subject to a quick decay).

*Dwell Time Model.* Ward and Shapiro (1996) proposed that T1 and T2 compete for visual processing resources. Usually, T1 is the winner of the competition and therefore T2 is lost. AB is due to the time taken to process T1 (500 ms - 600 ms). This model does not give an explanation of lag 1 sparing.

*Delayed attentional reengagement account.* According to this model (Nieuwenstein, 2006; Nieuwenstein, Chun, van der Lubbe, & Hooge, 2005; Nieuwenstein & Potter, 2006; Nieuwenstein, Potter, & Theeuwes, 2009), top down attentional resources to process the stimulus are engaged when T1 appears in a RSVP procedure. When a distractor item or just a gap (blank stimuli) follows T1 the resources are disengaged from the RSVP stream. AB occurs due to the time expenditure necessary for reengaging top down attention to T2. This model does not explain the Lag 1 sparing (i.e., whether Lag 1 sparing is caused by the T1+1 characteristics or due to the temporal interval between T1 and T2).

*Locus coeruleus-norepinephrine model.* In this model, Nieuwenhuis, Gilzenrat, Holmes and Cohen (2005) hypothesized that target stimuli in a RSVP stream trigger locus coeruleus (LC) neurons, which causes the release of norepinephrine in those brain areas that are innervated by LC neurons. The duration of norepinephrine modulation takes less than approximately 200 ms. After this initial trigger, the LC goes into a refractory period where it does not respond to following target stimuli for about 500 ms.

All these models identify the cause of the AB as a limitation in attentional resources. In sum, when observers attempt to detect and identify these two targets, identification of T2 is impaired when it follows T1 within approximately 500 ms because attentional resources cannot be adequately allocated to a subsequent second target stimulus (T2).

### 1.6.2 The Pop Out effect

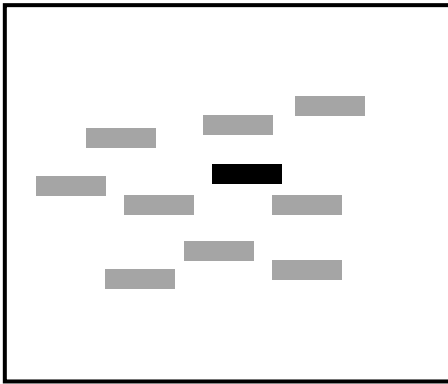
First of all it should be noted that Pop Out effect (POE) is usually not measured in RSVP and that POE is usually measured in tasks where stimuli is spatially presented (e.g., visual search) and not temporally presented (e.g., RSVP).

POE refers to a phenomenon that occurs in visual search (VS) tasks, in which a unique visual target (e.g., a feature singleton) can be rapidly detected among a set of homogeneous distractors (Treisman & Souther, 1985; Wolfe, 1994). In VS paradigms the participant is asked to search for a target (an object or feature) among distractors (other objects or features)<sup>13</sup>. This paradigm makes it possible to define a target either by a single feature (for example, only the color feature such as a black feature) or by a conjunction of features (for example, the color and the orientation such as a black horizontal line). The two most important models developed to explain the findings in the VS experiments were developed by Treisman and Gelade (1980) and Wolfe (1994). In 1980, Treisman and Gelade proposed a model (Feature-Integration Theory of Attention, FIT) in which it is assumed that features come first in perception. According to this model "...features are registered early, automatically, and in parallel across the visual field, while objects are identified separately and only at a later stage, which requires focused attention" (Treisman & Gelade, 1980, p. 98). The FIT model explains how feature search (and consequently the Pop Out effect) and conjunction search work in VS tasks. Feature search was defined as a parallel process in which the target and the distractors are different, differentiated by a single property (e.g., color, orientation, size, shape). In the feature search the participant is asked to, as rapidly as possible, pick a target stimulus among

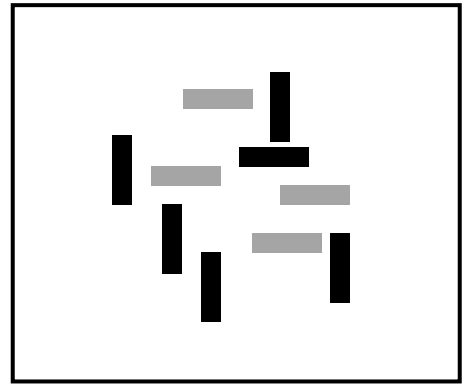
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<sup>13</sup> Usually the dependent variables in VS are the reaction time (i.e., time taken by the participant to produce an answer) and the accuracy of the response (i.e., the number of correct responses). In the most part of the VS experiment, the stimuli are shown until the choice of the participant has been made (in this case researchers measure the reaction time and the accuracy of the response) however if the presentation time of the stimuli is very short (below 150 ms) only the accuracy of the response is calculated.

distractors. An example of feature search is shown in Figure 3. Conjunction search occurs when the target and the distractors share similarities in more than one single visual property (i.e., color, orientation, size, shape). An example of conjunction search is shown in Figure 4. The similarities with the distractors (some distractors have the same color of the target while other distractors have the same orientation of the target) makes the target more difficult to detect as there is no 'pop out' effect as in feature search. This top-down process search produces much slower reaction times as it requires the participant to employ previously stored knowledge of the target in order to locate it.



*Figure 3.* Feature search. In this task, the participant is asked to pick out a black bar (target) located within a group of grey bars (distractors). As can be seen, the black bar pops out among 9 distractors.



*Figure 4.* Conjunction search. In this task, the participant is asked to pick out a black horizontal line (target) within a group of grey horizontal lines and black vertical bars (9 distractors).

Treisman and Gelade (1980) hypothesized that the visual system performs a preliminary analysis of an image based on some primary features, such as shape, color, and orientation. This information is processed prior to directed attentional processes, which operate serially and combine the basic features into a coherent representation. If the target has a unique feature (feature search), the target is located effortlessly; thus, the targets appear to "Pop Out" among the distractors



regardless of the number of distractors present in the display. In this case (parallel search), the module that analyzes this feature immediately reports the presence of the element to the response mechanisms, so that this element can be detected and discriminated from distractors. In contrast, conjunction search is a serial search. It requires the participant to attend to each individual item in the display until the target is located.

In VS experiments (where participants searched sets of items for targets defined by conjunctions of color and form, color and orientation, or color and size), Wolfe (1994) found that searches for triple conjunctions (Color x Size x Form) were easier than searches for standard conjunctions independently of the set size. To explain these findings, Wolfe proposed a model called guided search model. In this model, parallel processes use information about features to guide attention in the search for conjunctions. According to this model, the triple conjunctions are found more quickly than standard conjunctions because three parallel processes can guide attention more effectively than two.

## 2 Using Attentional Blink and Pop Out effect in a dual-target Rapid Serial Visual Presentation (dtRSVP) to measure hidden psychological constructs

### 2.1 Attentional Blink

#### 2.1.1 Emotion and Attentional Blink

In the last decade, a few studies (see the next paragraph) have explored the possibility to use the evaluation of the magnitude of AB in a dtRSVP procedure as an attention-based measurement procedure to identify deviant sexual interest. The basic idea in these studies relies on the hypothesis that predicts that AB will be increased when T1 has some salience (e.g., sexually preferred) to the viewer. If T1 is emotionally arousing, it will receive preferential attention at the expense of attentional resources directed to process the following T2. In sum, the “special attention” dedicated to the emotionally arousing T1 hampers the correct identification of the T2. Research suggests that, irrespective of the valence of the emotionality of the stimulus (i.e., positive vs. negative), arousal value was found to be responsible for AB sparing (Anderson, 2005) and the effects of the processing of T1 on attention depend on the arousal caused by the emotionality of the stimulus itself (Schimmack & Derryberry, 2005).

Most, Chun, Widders, and Zald (2005) asked participants to search for a single target in an RSVP and this target was either preceded by an irrelevant, emotionally negative or neutral image by either two or eight steps. They found that at the shorter lag, negative pictures (people or animals and including graphic images of violence, distress, and medical trauma) spontaneously induced greater deficits in target processing than neutral pictures did. They concluded that “attentional biases to emotional information induced a temporary inability to process stimuli that people actively sought”. Recently, McHugo, Olatunji and Zald (2013), named the phenomenon with the term ‘Emotional Attentional Blink’.

To explain the effects of emotional stimuli on the magnitude of the AB, Most, Wang and colleagues (Most & Wang, 2011; Wang & Most., 2012) proposed an alternative model to the “classic” bottle-neck model. They suggested that emotional distractors cause an amplified competition for perceptual resources during stage 1 rather than limiting awareness at the central bottleneck stage. According to this model, the emotional stimulus inhibits spatio-temporally adjacent goal relevant stimulus representations (in McHugo, Olatunji, & Zald, 2013).

Sexual stimuli (e.g., erotic pictures or sexual words) are generally rated as both emotionally positive and highly arousing by both men and women (Bradley, Codispoti, Cuthbert, & Lang, 2001; Lang, Strauss, Bradley, Dimoulas, Sloan, Soler Blaillo, 2001) and can be considered evolutionarily valuable stimuli (e.g., drive the attention to a potential mating opportunity).

In a single target Rapid Serial Visual Presentation, Most and his colleagues (2007) found that erotic stimuli induced spontaneous attentional blinks similar to those seen following negative pictures (Most, Chun, Widder, & Zald, 2005). In their experiments, when participants searched for a target embedded in a RSVP stream of pictures, positively arousing emotional distractors captured and held attention to such a degree that they created deficits in processing the subsequent target. The authors coined these findings “emotion-induced blindness” or “attentional rubbernecking”.

In Arnell, Killman, and Fijavz (2007), participants performed single target search in a single target Rapid Serial Visual Presentation, but in this study the target was preceded by a to-be-ignored distractor varying in valence and arousal, found that sexual words captured the attention when presented to the participants as distractors during RSVP. If the critical distractor was a sexual word, the researchers observed a decrease in accuracy or report of the target.

In conducting a single target Rapid Serial Visual Presentation, Mathewson, Arnell, and Mansfield (2008) found that AB was larger when taboo words were presented as a first target (T1), as compared with the AB found when

emotionally neutral, negative, or positive words were presented as T1. They suggested that taboo words had preferential attentional processing. They observed similar findings when taboo words were presented as to-be-ignored distractors in single-target RSVP. Moreover, they found that arousal, but not valence ratings of the emotional words predicted accuracy on subsequent targets in both dual and single task RSVP.

Ciesielski and colleagues (2010) found that at lag 2 (i.e., just one stimuli between the distractor and the target), erotic images induced the greatest deficits in subsequent target processing compared to other images, consistent with a large emotional attentional blink.

In the wake of these findings, a few studies were conducted to explore the possibility to use the evaluation of the magnitude of the AB in RSVP as an attention-based measurement procedure of deviant sexual preference (DSP). However, as has been noted recently by Didierjean, Maquestiaux, Vieillard, Ruthruff, and Hartley (2014) the findings of research using emotional stimuli in RSVP procedure are discrepant. In fact, some researchers have not found that the AB was increased with emotional stimuli (e.g., Huang, Baddeley & Young, 2008; Stein, Zwickel, Ritter, Kitzmantel, & Schneider, 2009; Mickley Steinmetz, Muscatell, & Kensinger, 2010; Didierjean, Maquestiaux, Vieillard, Ruthruff, & Hartley, 2014).

For example, Mickley Steinmetz, Muscatell, and Kensinger (2010) observed that when participants had to report two targets, the use of an emotional word as the T1, whether positive or negative in valence, increased detection of the T2. Didierjean and colleagues' (2014) findings went in the same direction. They conducted two experiments: in the first one, they found that both younger and older participants were better at identifying a target (the name of a color) when it was preceded by a sexual word rather than by a musical word; in the second one, they found that introducing a variable delay between the distractor and the target eliminated the sexual-word advantage. They concluded that the finding of Experiment 1 (i.e., the sexual-word advantage) was due to learning to utilize the

sexual word as a temporal cue with a fixed duration between the distractor and the target.

In sum, emotional stimuli affect the AB, but the patterns are unclear. The difficulty of reaching a definitive conclusion of how the emotional stimuli affect the AB, is due to different designs, procedures and materials in the studies (e.g., single or dual-target Rapid Serial Visual Presentation, number of fillers, the time interval between the presentation of T1 and T2 in the case of dual-target Rapid Serial Visual Presentation, and/or type of stimuli).

Moreover, it should be considered that positive/negative and approach/avoidance is not the same dimension. For example, disgust is an avoidance/negative emotion, but anger is an approach/negative emotion. In trying to understand these effects, in future studies, it might be helpful to consider the emotional value not as unidimensional but multidimensional.

#### 2.1.2 Previous studies using Attentional Blink in dtRSVP as an attention-based measurement procedure of DSP and sexual preference

The basic idea in using the AB to identify DSP is that during the view of stream of visual stimuli in a dtRSVP, participant's attention is captured by the T1 stimuli that are emotionally arousing in terms of being sexually preferred. So, for example, participants who have a DSP will find pictures of a prepubescent individual more emotionally arousing than pictures of an adult, therefore an increased AB (i.e., a decrease in accuracy in the reporting of T2) is expected when T2 follows a T1 depicting prepubescent children, compared to when T2 follows a T1 depicting an adult.

In studies attempting to use the AB to measure sexual preferences, arrays of visual stimuli were shown, and participants were required to report the T1 and T2 stimuli according to a typical dtRSVP procedure (see Figure 1, p. 33). To my knowledge, five studies, using the evaluation of AB in dtRSVP as an attention-based measurement procedure of deviant sexual preference (DSP), have been conducted.

Kalmus (2003)<sup>14</sup> assessed the possibility of using the AB effect to differentiate between individuals belonging to two groups (36 child sex offenders and 20 non-offender participants). Kalmus used a sequence of images, eight distractors and two target images. The T1 image of either a clothed child or an animal was closely followed by a T2 image of either a train or a chair. Participants were required to accurately report both targets. They found that a larger AB emerged in the sample of child molesters when T2 was an image of a clothed child compared to when T1 was an image of an animal.

Beech, Kalmus, Tipper, Baudouin, and Flak (2008) used images of children and animals as T1 and investigated the differences between the effects of these two stimulus types on the AB in a sample of 35 child sex offenders (16 intrafamilial, 19 extrafamilial) and seventeen non-sex offenders. The study consisted of two report conditions: 1) T1 and T2 had to be reported (dtRSVP). In this condition participants reported whether they saw a child or an animal (T1) and then whether they saw a train or a chair and its direction (oriented to the left or right); 2) only T2 had to be reported (single target Rapid Serial Visual Presentation). In this condition, participants reported whether they saw a train or a chair and its direction (left or right). In each trial, participants viewed a stream of 11 images. Two hundred and sixteen T1 stimuli were used (108 non nude children or 108 animals) and 216 were used as T2 stimuli (trains and chairs, half facing left and half facing right). The T1 child category images (the age of the children varying from 6 to 11 years old) included facial, half-length and full-length images of either a single child or groups of children in natural settings. Sex and ethnic group stimuli were used, with the weightings reflecting the recorded characteristics of the children who were molested. The T1 animal images included reptiles, birds, domestic and wild mammals. T2 stimuli consisted of 216 images (trains, chairs, half oriented to the left and half oriented to the right). The researchers hypothesized that due to AB; 1) child sex offenders, compared with the non sex offenders, would have a decrease in

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<sup>14</sup> Unpublished doctoral thesis, University of Birmingham, UK.

accuracy in the reporting of T2 following the explicit naming of a T1 image of sexual or emotional salience to the them; 2) the decrease in accuracy in the reporting of T2 following the explicit naming of a T1 images of children will be particularly manifested in extrafamilial child sex offenders because of a hypothesized stronger sexual preference in children in the extrafamilial group compared with incestuous offenders.

Regarding hypothesis 1, in condition 1 (dtRSVP) researchers found that child molesters, compared with a control group of offenders who did not molest children, decreased the accuracy in the reporting of T2 stimuli following the explicit naming of a T1 image of sexual or non-sexual images of children. Significant differences were found between the control group and the intrafamilial child molester group, and between the control group and the extrafamilial child molester group, when comparing the accuracy in the reporting of T2 when T1 stimuli were pictures of animals or children. In condition 2, the researchers found that both child molester samples were less accurate in the reporting of T2 when T1 was a picture of a child rather than a picture of an animal. The participants in the control group were less accurate in the reporting of T2 when T1 were animal stimuli. Regarding hypothesis 2, no significant difference was found in the performance of the intra- and extrafamilial child molester groups.

Crooks, Rostill-Brooks, Beech, and Bickley (2009) evaluated the magnitude of AB among 20 adolescent sex offenders and 26 non-sex offenders using RSVP. Their RSVP presented 216 ten-image sequences, comprised of T1, T2, and eight neutral distractor images. Of the 216 T1 images, half were animals and half children. Animals included domestic pets and wildlife animals. The child images were of clothed pre-adolescents of varying gender and ethnicity. Of the 216 T2 images, half displayed chairs and half displayed trains. Half of the trains and chairs were oriented to the left and half to the right. Each of the 10 images within a sequence was displayed for 100 ms. T1 was always followed by T2, but the interval between them could vary by a maximum of 300 ms. Participants

were asked to report whether they had viewed an animal or a child (T1) and then a train or a chair, and whether they were oriented to the left or to the right (T2). For offenders against children a stronger AB effect was expected after viewing child rather than animal images, but the expected differences between offender groups were not found. The authors hypothesized that their failure to produce similar results to the study conducted by Beech and colleagues (2008) could reflect the fluid nature of sexual preferences during the sexually formative years of adolescence.

Flak (2011) investigated if the RSVP could detect sexual interest in child images with a sample of 14 extrafamilial child sex offenders, 12 intrafamilial child sex offenders, 17 non-sexual offenders and a control group. In the same study Flak, explored the potential bias of anxiety, social desirability, and IQ related to performance on the RSVP. The stimuli were all drawn from 610 commercially available images, 216 were used as T1 stimuli divided into 178 neutral images, 108 animals and 108 child images (the depicted children were all clothed). 216 were used as T2 stimulus, with 108 trains and 108 chairs (half facing left/half facing right). T1 child images portrayed children in natural settings, either full body or facial images of either a single child or children in groups. The age of the depicted children ranged between 6 and 11 years old. The T1 animal images included domestic and wild mammals, birds and reptiles. Images were again facial, half-length or full-length pictures of single or groups of animals in natural settings. The procedure consisted of two conditions that were counterbalanced in order to control for order effects. In Condition 1 the participants had to report T1 and T2 (dtRSVP), investigating whether an increase in error rate was detected in T2 when T1 was accurately reported. In Condition 2 the participants had to report T2 only, this in order to measure and control for difficulty in reporting T2 when T1 did not have (single target Rapid Serial Visual Presentation) to be reported. Each trial consisted of 11 images, divided into 4 blocks (there was a short break in between each block), with 216 trials in total. In order to reduce the primacy and recency effect, images in each



sequence were sequentially presented for 100 milliseconds and the first and last image was neutral in every sequence. T1 image was always positioned between the second and the seventh position. T2 was always positioned between the third and ninth position, and it followed either immediately or immediately after the presentation of T1. The pictures assigned to the particular interval were counter-balanced across participants within each group. The analysis used T2 detection accuracy as a dependent variable for both conditions when T1 was also accurately identified in Condition 1. T2 stimuli had one of four separate responses (chair left, chair right, train left, train right), therefore chance level for accurate detection was at 25%. The analysis showed a significant interaction between image category and group, suggesting that image category had a differing effect across the three groups. This effect was due to the difference in performance of the groups, where extrafamilial offenders displayed lower T2 accuracy when T1 was a child compared to when it was an animal, in the intrafamilial group an opposite pattern was observed. A main effect of interval was also found.

In the same study no significant interaction effects between anxiety or social desirability and T2 accuracy were found. This suggests that anxiety does not affect the magnitude of the AB and that social desirability did not exert a significant effect on T2 accuracy across all groups. Moreover, the results show that participant's IQ affects the magnitude of the AB.

Differently from the aforementioned studies, a few studies have also been conducted using the evaluation of AB in dtRSVP as an attention-based measurement procedure of non-deviant sexual preferences<sup>15</sup>. We report these studies, because as we mentioned before, before testing forensic populations of

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<sup>15</sup> As mentioned in the abstract (p. 13), before testing forensic populations of sex offenders, in order to calibrate the procedures, we conducted three studies investigating the possibility to differentiate between homosexual and heterosexual men and investigating the fakeability of the procedure measurement (the groups consisted of homosexual men, heterosexual men and faker participants).

sex offenders, we conducted studies in order to calibrate the procedure, in which the fakeability of the procedure was assessed and the efficacy of the images from VPS was tested.

Using erotic images (clothed/nude and male/female individuals) in a RSVP procedure in a sample of heterosexual men and women, Grace (2005), found that images of nude individuals induced a larger AB compared to images of clothed images and that images of nude females elicited a large AB in the men (in contrast, images of nude males did not elicit a greater AB than images of nude females in women) (Grace, 2005 in Flak, Beech, Humphreys, & Glyn, 2009, p. 153). However, Hudson (2005), using images of clothed males and females, failed to find differences between the effects of T1 images depicting clothed males and females and women (Hudson, 2005 in Flak et al., 2009, p. 153).

Using a sample of 32 participants (16 heterosexual men and 16 heterosexual women), Flak (2011) did not find any difference in the magnitude of AB in a RSVP procedure with two conditions. In Condition 1 AB was calculated by looking at accuracy in reporting T2 when T1 was reported accurately. In Condition 2, AB was calculated by looking at T2 accuracy and whether this was influenced by the preceding T1. No significant differences were found between the two groups regarding their responses to images depicting their preferred sexual interest (nude male and female images).

Finally, Flak (2011) investigated if men who had children under the age of two respond in a similar manner to stimuli as child sex offenders. She found that 'new fathers' showed very similar responses to the control group (the control group consisted of 17 convicted offenders with no previous sexual offending), suggesting that also a non-sexual interest in children affected the target detection rates.

In light of the findings we predicted that the correct identification of T2 would increase if T2 was a sexually preferred image compared to when T2 was not a sexually preferred image. Therefore, we expected that: in homosexual men, T2 would be more accurately reported when T2 was an image of a male

compared to when T2 was an image of a female; in heterosexual men, T2 would be more accurately reported when T2 was an image of a female compared to when T2 was an image of a male; and when a correctly reported T1 belonged to the preferred gender and maturity level, the accuracy in the reporting of T2 would decrease in comparison to when T1 did not belong to the preferred gender and maturity level.

## 2.2 Pop out effect

### 2.2.1 Theoretical background

It has been found that AB is reduced (i.e., accurate reporting of T2 is relatively less decreased after the correct identification of T1) if T2 is particularly salient to the viewer (Keil & Ihssen, 2004; Anderson, 2005; Arnell, Killman, & Fijavz, 2007; Schwabe et al., 2011; Gantman & Van Bavel, 2014). Examining affective modulation of the AB effect during dtRSVP, Keil and Ihssen (2004) found that the AB was reduced when T2 consisted of an arousing word (e.g., sexually explicit). Exploring the processing of emotional vs. neutral linguistic stimuli with dtRSVP procedure, Anderson (2005) found that the AB was attenuated when sexual/taboo words were presented as T2. In a single target Rapid Serial Visual Presentation, Arnell, Killman, and Fijavz (2007) found that sexual words captured attention when presented as distractors during RSVP and provoked a smaller AB. Searching for the neural underpinnings of the emotional modulation of the attentional blink, Schwabe and colleagues (2010), found that emotionally arousing T2 reduced the AB.

Taken together, these findings reveal that emotionally arousing T2 stimuli (e.g., sexual), at least partially, prevail over the attentional limitations causing the AB. This phenomenon can be viewed in terms of the POE. As earlier described, the POE refers to a phenomenon that occurs in visual search tasks, in which a unique visual target (e.g., a feature singleton) can be rapidly detected in a set of homogeneous distractors (Treisman, 1985; Wolfe, 1994). It can be argued, that the emotional valence of the stimulus represents dissociable target

characteristics among homogeneous distractors. So, due to a POE, the emotional arousing T2 breaks through and partially reduces the AB phenomenon in a dtRSVP procedure.

The aforementioned studies found a POE on T2 but did not investigate the POE on T1. Similarly, it is predictable that if T1 has the same features that make T2 pop out, then also T1 will pop out (e.g., the emotional arousing valence of T1 stimuli facilitate their detection). Therefore, it is expected that sexual T1 stimuli will be more accurately reported than non-sexual T1 stimuli. In our study, we predicted that the correct identification of T1 and T2 would increase if T1 and T2 consisted of sexually preferred images compared to when T1 and T2 did not consist of sexually preferred images. Therefore, we expected that: in homosexual men, T1 and T2 would be more accurately reported when T1 and T2 portrayed a male compared to when T1 and T2 portrayed a female; in heterosexual men, T1 and T2 would be more accurately reported when T1 and T2 portrayed a female compared to when T1 and T2 portrayed a male. Moreover, the accuracy in the reporting of T1 and T2 would be relatively increased when T1 and T2 portrayed the preferred gender and maturity level compared to when they did not.

#### 2.2.2 Reviews of previous studies using Pop Out in dtRSVP as an attention-based measurement procedure of DSP

To my knowledge, no studies have investigated the Pop Out effect in dtRSVP as an attention-based measurement procedure of DSP.

The idea, to also use the Pop Out in dtRSVP as an attention-based measurement procedure of DSP, is based on the expectation that the proportion of correctly identified T1 and T2 increase if they are sexually preferred. Again this means that T1 and T2 are preferred (or not preferred) in terms of gender and maturity and that secondary sexual characteristics of a stimuli can be conceptualized as feature singletons that provoke a Pop Out effect.

### 3 Fakeability of the dtRSVP as a measurement procedure to identify non deviant sexual preference

Response bias, response sets and response styles, response distortion, socially desirable responding, and malingering are some of the terms used to indicate faking in the context of psychological assessment. However, an effective and synthetic definition of faking has been stated by Paulhus (2002, p. 50) who defined faking as “The tendency to give overly positive self-descriptions”. Following this definition, Zigler and colleagues (e.g., Ziegler & Buehner, 2009; Ziegler, Toomela, & Buehner, 2009; Heggstad, George, & Reeve, 2006; Ziegler, MacCann, & Roberts, 2012) define faking as an interaction between a person and a situation, arguing that “Faking represents a response set aimed at providing a portrayal of the self that helps a person to achieve personal goals” (Zigler, Maccan, & Roberts, 2012, p. 8). These definitions help us to enter in the gist of our issue. In fact, if the danger of faking is always a threat in personality assessment (see Rothstein & Goffin, 2006 for a review on research on faking and personality assessment), faking and defensiveness are often intrinsically embedded in forensic assessment. In forensic assessments, sexual offenders against children could be interested in hiding their deviant sexual preference from the examiners. To arrive at a valid assessment tool it would therefore be useful to have a measurement that reduces the impact of faking.

As we have seen (see chapter 3), no currently available assessment tool for DSP is totally immune to faking. However, attention-based measurement procedure is supposed to be less susceptible to faking than other tools (e.g., interviews, questionnaires, or PPG). These methods take advantage of the fact that sexually relevant stimuli are automatically attended to, causing detectable delays in concurrent cognitive tasks, rendering these methods less susceptible to willful manipulation of the outcome. In Kalmus and Beech's (2005) paradigm, a

hypothetical high value of resilience to faking was assigned to the attentional method of measurement.

To give an idea of how important this issue is, the website [innocentdads.org](http://innocentdads.org) reads:

to all of the Fathers who have gone through, or are going through, or will be going through a nasty custody battle where you are falsely accused of many various charges.”, there is a section of the website focused on Abel Assessment for sexual interest (Abel Assessment for sexual interest-3, AASI-3)<sup>16</sup>. On the [innocentdads.org](http://innocentdads.org) website, there is a brief overview on the theoretical backgrounds of the Abel Assessment and what parameter is measured and how is interpreted.

**REACTION TIME** - You will be shown these series of slides 2 times, the first time **ONLY** measures how long you view each slide. If you view a particular slide longer than another one, then the developers of this test believe that you have a desire to be attracted to this sexually deviant behavior. In other words, if you take longer to look at a picture of a lady dressing through a window, then you have an interest in voyeurism. If you look longer at children in bathing suits, then you have a sexual interest in children. If you take longer to view a picture of women in bondage, then you probably have a sexual desire towards this behavior. This may not be true, but if you make the mistake of taking extra time, then you **WILL** be labelled as a child molester, a person who enjoys voyeurism, or a person who enjoys bondage.

**WHAT IS CONSIDERED A LONG REACTION TIME?** - It is all based on your average time looking at all of the pictures. If you look at each of the "normal" pictures for 2 seconds, and look at the more perverted pictures for 5 seconds, plan of being labelled "a pervert". I don't want to tell you what to do, but if you are a normal person, then your reaction time to the perverted pictures will be **LESS** than the normal pictures.

**FINAL THOUGHTS** - I do not want to tell you what the right answers are to the various questions, nor is this page devoted to "deceiving the Abel Assessment". The purpose of this page is rather to educate you on what the Abel Assessment **REALLY** investigates. Also do understand that this test will not determine whether you have committed a crime or not, but rather if you have tendencies towards abnormal sexual desires<sup>17</sup>.

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<sup>16</sup> On the website <http://abelscreening.com/products/evaluation-treatment-planning/aasi-3/> we can read that “*The Abel Assessment for sexual interest-3™* (AASI-3) is an empirically validated, comprehensive evaluation and treatment assessment system for clinicians, used with adult men and women having problematic sexual behavior. It is specifically designed to measure a client’s sexual interests and to obtain information regarding involvement in a number of abusive or problematic sexual behaviors” (retrieved on 1 of April, 2014).

<sup>17</sup> Innocent Dads, Guilty until Proven Innocent! Dads, falsely accused fathers and their legal issues! (n.d.). Retrieved December 2, 2014, from <http://www.innocentdads.org>.

Regarding the fakeability of the Abel Assessment's method, Abel (1996, 1997) conducted a study to test whether subjects can falsify their responses to the measurement procedure to a previous version of his tool. The test was administered twice with different instructions to two groups (pedophiles who denied their behavior and those determined to be pedophilic participants who admitted their behavior). In one condition, the participants were instructed to hide their responses and in another condition the participants were instructed duly to perform the test. When pedophilic participants were told to modify their visual reaction times and self-report of sexual interest, a change was observed in their raw score, but the rank order of target victim categories was unchanged.

Fischer and Smith (1999, p. 201) pointed out some concerns regarding that "no data were presented from the ANOVA to justify the conclusion that, although subjects' raw VT changed across administration, the scores always changed in the same direction."<sup>18</sup> Sachsenmaier and Gress (2009, p. 46) concluded that "unfortunately, this study does not appear to be on the website currently and it does not appear to be published. If these results are submitted to and stand up to peer review, this could be an important and useful finding. Publication of the methodology would enable the reader to decide."

In a recent study, Dombert and colleagues (in press) examined how susceptible the CRT is to faking. They investigated the possibility to identify heterosexual male participants instructed to respond like homosexual male participants. Heterosexual male ( $n = 24$ ), homosexual male ( $n = 29$ ) participants, and heterosexual male ( $n = 23$ ) participants that were instructed to respond like homosexual male participants completed a CRT. Dombert and her colleagues found that the faking group was significantly slower than both the heterosexual and homosexual male participants. The authors explained these findings with the effect of the cognitive load to following the faking instruction. Moreover, they

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<sup>18</sup> It should be noted that Fischer and Smith argued (1999, p. 201) "This study might be misinterpreted as a validity study because the term "falsifying" is used in the title and it is placed in the validity section of the technical report, but it is actually a study of reliability."

found that the faking group was able to alter its RT pattern in the expected direction. As expected, the fakers showed longer RTs in response to images depicting males and had overall longer RTs than the heterosexual and homosexual male participants. In order to assess the capacity of the CRT to differentiate between fakers' and the two other groups' indices, Dombert and her colleagues created an index (fake index) that was calculated by subtracting the individual mean RTs to scrambled pictures, from the RTs to figural pictures (naked and clothed depictions) which were expected to evoke longer RTs in fakers than in other participants due to cognitive load. The fake index separated the fakers from the other two groups with AUC values from .78 to .91 that can be compared to Cohen's  $d$ : 1.02 - 1.86. When we consider faking as "The tendency to give overly positive self-descriptions", it should also be noted that Flak (2011), in a sample of 12 incarcerated intrafamilial and 14 incarcerated extrafamilial child sex offenders and a control group, tested the potential bias of social desirability related to performance on the RSVP, and found that social desirability did not exert a significant effect on T2 accuracy across all groups.

In conclusion, the hypothesis of the resilience to faking during the attentional methods of measurement of DSP and sexual orientation has received some support but further research is necessary. Moreover, it should be noted that it is questionable whether the results regarding the fakeability of sexual orientation can be generalized directly to the faking of DSP (i.e., pedophilia).

To our knowledge, no studies have been published in order to test the fakeability of dtRSVP as a measurement procedure to identify sexual preference.



## 4 Stimuli Development Study

### 4.1 Overview of the issue

In order to evaluate the presence or the absence of a Deviant Sexual Preference (DSP), an attention-based measure should administer different types of sexual stimuli to the participants, and assess to which types of stimuli the participants show sexual arousal. The use of visual stimuli depicting children in research and assessment concerning pedophilia necessitates a careful evaluation of the ethical and legal boundaries.

In the last years, attempts have been made to define which characteristics a picture must have in order to be considered child pornography. In the United States the court developed six criteria (known as Dost criteria) in order to determine whether a visual depiction of a child constitutes a "lascivious exhibition of the genitals or pubic area" under 18 U.S.C.§2256 (Sexual exploitation of children) following the trial (United States v. Dost, 1986):

Whether the focal point of the visual depiction is on the child's genitalia or pubic area.

Whether the setting of the visual depiction is sexually suggestive, i.e., in a place or pose generally associated with sexual activity.

Whether the child is depicted in an unnatural pose, or in inappropriate attire, considering the age of the child.

Whether the child is fully or partially clothed, or nude.

Whether the visual depiction suggests sexual coyness or a willingness to engage in sexual activity.

Whether the visual depiction is intended or designed to elicit a sexual response in the viewer.

The project *Combating Paedophile Information Networks in Europe* (COPINE; Taylor, Holland, & Quayle, 2001) outlined 10 levels to categorize child abuse images for use in both research and law enforcement:

*Indicative.* Non-erotic and non-sexualized pictures showing children in their underwear, swimming costumes from either commercial sources or family albums. Pictures of children playing in normal settings, in which the context or organization of pictures by the collector indicates inappropriateness.

*Nudist.* Pictures of naked or semi-naked children in appropriate nudist settings, and from legitimate sources.

*Erotica.* Surreptitiously taken photographs of children in play areas or other safe environments showing either underwear or varying degrees of nakedness.

*Posing.* Deliberately posed pictures of children fully clothed, partially clothed or naked (where the amount, context and organisation suggests sexual interest).

*Erotic Posing.* Deliberately posed pictures of fully, partially clothed or naked children in sexualised or provocative poses.

*Explicit Erotic Posing.* Pictures emphasising genital areas, where the child is either naked, partially clothed or fully clothed.

*Explicit Sexual Activity.* Pictures that depict touching, mutual and self-masturbation, oral sex and intercourse by a child, not involving an adult.

*Assault.* Pictures of children being subject to a sexual assault, involving digital touching, involving an adult.

*Gross Assault.* Grossly obscene pictures of sexual assault, involving penetrative sex, masturbation or oral sex, involving an adult.

*Sadistic/Bestiality.* a) Pictures showing a child being tied, bound, beaten, whipped or otherwise subject to something that implies pain. b) Pictures where an animal is involved in some form of sexual behavior with a child.

From an ethical and legal point of view, stimulus material used for determining pedophilic sexual interest should at most meet the criteria for the second level of the COPINE scale. This means pictures of naked or semi naked children in non-sexualized settings from unsuspecting sources.

Making pictures that depicts children is problematic, especially when the pictures will be used for identification on DSP. In fact, the children depicted neither can nor would give their informed consent for this use (Card & Olsen, 1996) and it could also be seen as problematic if parents or caregivers give their consent to produce suitable photographs of their children. Of course, for obvious reasons, it is also not possible to use child pornography materials on the web.

The only alternative seems to be to create pictures of children that are not real. At the moment, there are two picture sets currently available, the Not-Real People (NRP) set (Not-Real People stimulus set for assessment of sexual interest, 2004; see also Laws & Gress, 2004) and a set of three-dimensional characters (3D set; Renaud, Rouleau, Granger, Barsetti, & Bouchard, 2010).

NRP consists of computer-modified visual images, depicting people that meet the Tanner Criteria (all 5 stages represented in both genders, clothed, partially clothed and unclothed). All images are non-pornographic and non-sexual in nature. The Dost Criteria have been observed in their preparation. For the 80 nude stimuli within the NRP set (half of which depict females, and the remainder show males), Laws and Gress (2004) reported a good level of observer agreement in terms of maturity levels (average  $\kappa = .62$ , with a range from .39 to .89 across stimulus categories). For the 80 nude stimuli of the NRP, Mokros and colleagues (2011) found that the extreme categories (Tanner Stages 1 and 5) could be differentiated reliably in a paired comparison design but the intermediate ones could not.

In two studies pertaining to the use of virtual characters applied in clinical forensic rehabilitation of sex offenders, Renaud and colleagues (2010) used as sexual stimuli 3D virtual characters depicting realistic naked human individuals. Two adults, a female and a male, both designed to simulate individuals in their twenties, a female child and a male child, both prepubescent and aged between 10 and 12 years old, as well as a neutral stimulus. All characters were designed to simulate Caucasian mesomorphic body types according to Tanner's developmental criteria to fit the targeted age categories [stage 5 for the adults and stage 1 for the prepubescent children. Renaud and colleagues (2010, Study 2) noted significant differences in the erectile responses of 10 male child sexual abusers toward the 4 stimuli using PPG, compared with the erectile responses of 15 male controls.

## 5 Aims and research questions

The present thesis is part of a research project aiming to develop attention-based measurement procedure for the assessment of DSP. The general aim of this thesis was to develop a procedure using a dual-target Rapid Serial Visual Presentation (dtRSVP) to assess DSP. The studies investigated: a) if and how sexually preferred visual stimuli affect information processing of both a target one (T1) and a subsequent target two (T2) in a dtRSVP procedure and b) the ability of this procedure to differentiate between groups of interest (homosexual men vs. heterosexual men; homosexual and heterosexual men and fakers; child sex offenders, sexual offenders against adults, other non-sex offenders and community controls).

In **Study I**, in groups of homosexual and heterosexual men, we investigated if and how sexual preference moderated information processing of photos of actual men and women as target one (T1) and subsequent target two (T2) and the ability of this measurement to differentiate between the groups.

In **Study II**, in groups of homosexual and heterosexual men, we investigated if and how sexual preference moderated information processing of computer generated images of nude and clothed adolescent/adult, pubescent and pre-pubescent males and females from the Virtual People Set (VPS, Dombert et al., 2013) as target one (T1) and subsequent target two (T2) and the ability of this measurement to differentiate between the groups.

In **Study III**, in groups from a forensic population (child sex offenders, sexual offenders against adults, other non-sex offenders) and community controls, we investigated if and how sexual preference moderated information processing of computer generated images of nude and clothed adolescent/adult, pubescent and pre-pubescent males and females from the VPS (Dombert et al., 2013) as target one (T1) and subsequent target two (T2) and the ability of this measurement to differentiate between the groups.

In **Study IV**, in groups of homosexual men, heterosexual men and heterosexual men who tried to fake their sexual preference, we investigated if and how sexual preference moderated information processing of photos of men and adult women as target one (T1) and subsequent target two (T2) and the ability of this measurement to differentiate between the groups.

A summary of participants, stimuli, designs and purposes in all four studies are displayed in Table 1.

In all four studies, we formulated the two main hypotheses: a) due to a Pop Out effect, the amount of correctly identified T1 and T2 would increase if T1 and T2 consisted of a sexually preferred (i.e., in terms of gender and sexual maturity of the stimuli) image (photos in Study I and Study IV, computer generated images in Study II and Study III) compared to when T1 and T2 consisted of a sexually non-preferred image; b) due to AB, the correct identification of a T2 would decrease the following sexually preferred T1 compared to a sexually non-preferred T1 (for specific hypotheses in the different studies, see Study I, Study II, Study III and Study IV chapters).

Table 1  
*Participants, stimuli, designs and purposes in all four studies*

Study	Participants	Stimuli	Purpose
I	Male students (homosexual men $n = 17$ , heterosexual men $n = 18$ ) from Finland	480 pictures collected from pornographic Internet pay sites, containing only adult models. Half of the images were nude and half were clothed in a skin-colored “garment” covering them from the torso to their hips.	Differentiating sexual preference in men using dtRSVP
II	Males from the general population and students (homosexual men $n = 13$ , heterosexual men $n = 13$ ) from Finland, Germany and Italy	108 images of the VPS depicting both males and females varying in terms of explicitness (nude/clothed) and in terms of sexual maturity: prepubescent (Tanner 1), pubescent (Tanner 2/3) and adolescent/adult (Tanner 4/5)	Differentiating sexual preference in men using dtRSVP
III	Child Sex Offenders ( $n = 69$ ), Other Sex Offenders ( $n = 43$ ), Non Sex Offenders ( $n = 14$ ) and Community Controls ( $n = 88$ ) recruited in prisons and from the general community in Finland, Germany and Italy. All participants were males.	54 images of the VPS depicting both nude males and nude females varying in terms of sexual maturity: prepubescent (Tanner 1), pubescent (Tanner 2/3) and adolescent/adult (Tanner 4/5).	Separating deviant sexual interest in a forensic sex offender population using dtRSVP
IV	Male students (homosexual men $n = 9$ , heterosexual men $n = 8$ , heterosexual men faking to be homosexual [fakers] $n = 12$ ) from Finland. Homosexual and heterosexual participants were a subset of the sample in Study I.	480 pictures collected from pornographic Internet pay sites, containing only adult models. Half of the images were nude and half were clothed in a skin-colored “garment” covering them from the torso to their hips.	Testing the fakeability of dtRSVP as an attention-based measurement procedure of sexual preference

## Study 5 SDS-Study

This study consisted of three studies that addressed the reliability and validity of a novel set of picture stimuli developed for identifying pedophilic sexual interest. Studies 1 and 2 relied on student participants and used two different methods (rating, paired comparison) to test whether the stimuli were in accordance with the presumed three levels of biological maturity: prepubescent, pubescent, and adolescent/adult. Study 3 extended these findings to two other samples of men: first, a group of convicted and incarcerated offenders who committed child sexual abuse or child pornography offenses, and second, a group of normal controls from the general population. We formulated three hypotheses: 1) observers informed about the specifics of the five Tanner stages would reliably differentiate between stimuli according to the level of pubertal development that they supposedly depicted (Study 1)<sup>19</sup>; 2) laypeople would be able to distinguish between the sexual maturity levels of the stimuli reliably in a paired comparison design (Study 2); 3) convicted child sexual abusers would be able to reliably differentiate between stimulus categories in terms of sexual maturity (Study 3)<sup>20</sup>.

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<sup>19</sup> This study also served to choose an optimal set of stimuli with regard to degree of realism and attractiveness of the depictions.

<sup>20</sup> In this study we investigated if the realism and attractiveness of the pictures would be correlate positively. Compared with men from the community the child sexual offenders would show a different pattern of unobtrusively measured viewing time, with longer latencies for child images. Finally, child sexual abusers would attach higher ratings to pictures of prepubescent and pubescent children in terms of sexual attractiveness than community controls (Study 3).

## 6 METHOD

### 6.1 Participants

#### **Study I**

The sample consisted of 35 students from technical schools and universities in the Turku area (Finland). Participants were recruited through an e-mail to student union mailing lists and to a homosexual, bisexual and transgender student society. The e-mail invited addressees to participate in a cognitive test where both homosexual men and heterosexual men were required. Potential participants were asked to contact the testers. After completing the test, all participants received two free movie-tickets for participation.

#### **Study II**

The sample consisted of male 26 individuals from Finland, Germany and Italy. Participants were recruited through e-mails to student union mailing lists and to homosexual, bisexual and transgender student societies. In Italy the participants were recruited through snowballing sampling. The e-mails invited addressees to participate in a cognitive test where both homosexual men and heterosexual men were required. Potential participants were asked to contact the testers. After completing the test, all participants received two free movie-tickets for participation.

#### **Study III**

The sample consisted of 69 Child Sex Offenders (CSO), 43 Other Sex Offenders (OSO), 14 Non Sex Offenders (NSO), and 88 Community Controls (CC). CSO, OSO and NSO were in prison. The sample of offenders was recruited in Germany (from forensic hospital prison and prisons) and Italy (from a prison that houses both sex offenders and non sex offenders). CC participants were recruited through e-mails to student union mailing lists in Finland, while in Italy the participants were recruited through snowballing sampling. The e-mails invited addressees to take part in a cognitive test. All CC participants, after completing the test, received two free



movie-tickets for participation; all other participants received 10 euros for participation.

We were not able to gather offenders from Finland due the paucity of potential participants.

#### **Study IV**

The sample consisted of 29 students from technical schools and universities in the Turku area. Homosexual and heterosexual participants were a subset of Study I sample. The faker participants were recruited through an e-mail to student union mailing lists. The e-mails invited addressees to participate in a cognitive test where both homosexual men and heterosexual men were required. Potential participants were asked to contact the testers. After completing the test, all participants received two free movie-tickets for participation.

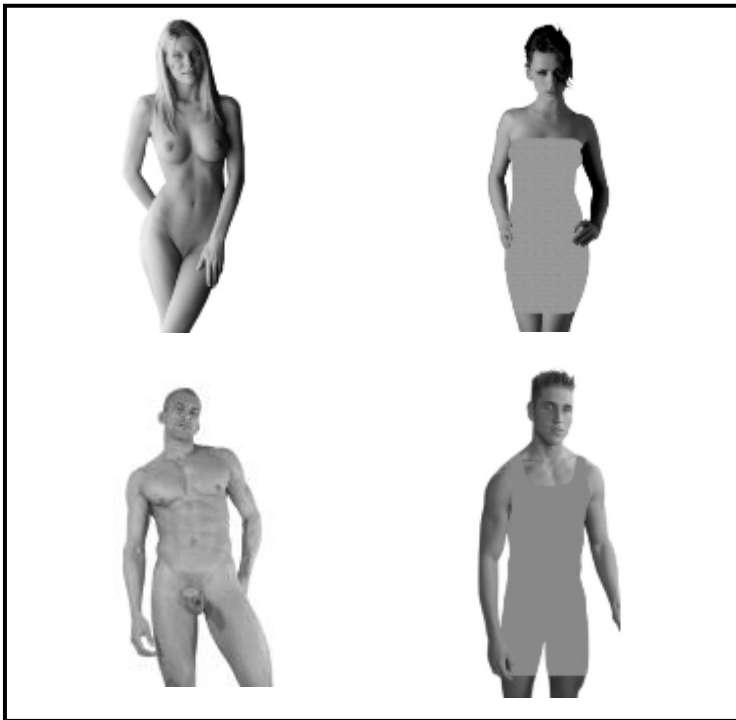
#### **Study V SDS-Study**

In study 1, participants were 20 (10 female, 10 male), in study 2, participants were 110 (55 male, 55 female), in study 3, 106 male participants took part in the study. 59 men were sampled from the community (community sample) and 47 individuals were inmates convicted either for a hands-on child sexual abuse offense or for the possession or distribution of child pornography.

## 6.2 Stimuli<sup>21</sup>

### Study I and Study IV

Picture stimuli were 480 pictures collected from pornographic Internet pay sites, containing only adult models, and screened so that the posture was three-fourth full frontal and so that the model had a neutral facial expression. Half of the images in each group were randomly selected and clothed in a skin-colored “garment” covering them from the torso to their hips using Adobe® Photoshop® CS2. All pictures were modified to be of the same resolution (72 pixels/inch), size (20 X 20 cm), and background color (white) (Figure 5).



*Figure 5.* Women and men photos, nude and clothed (i.e., skin-colored “garment” covering them).

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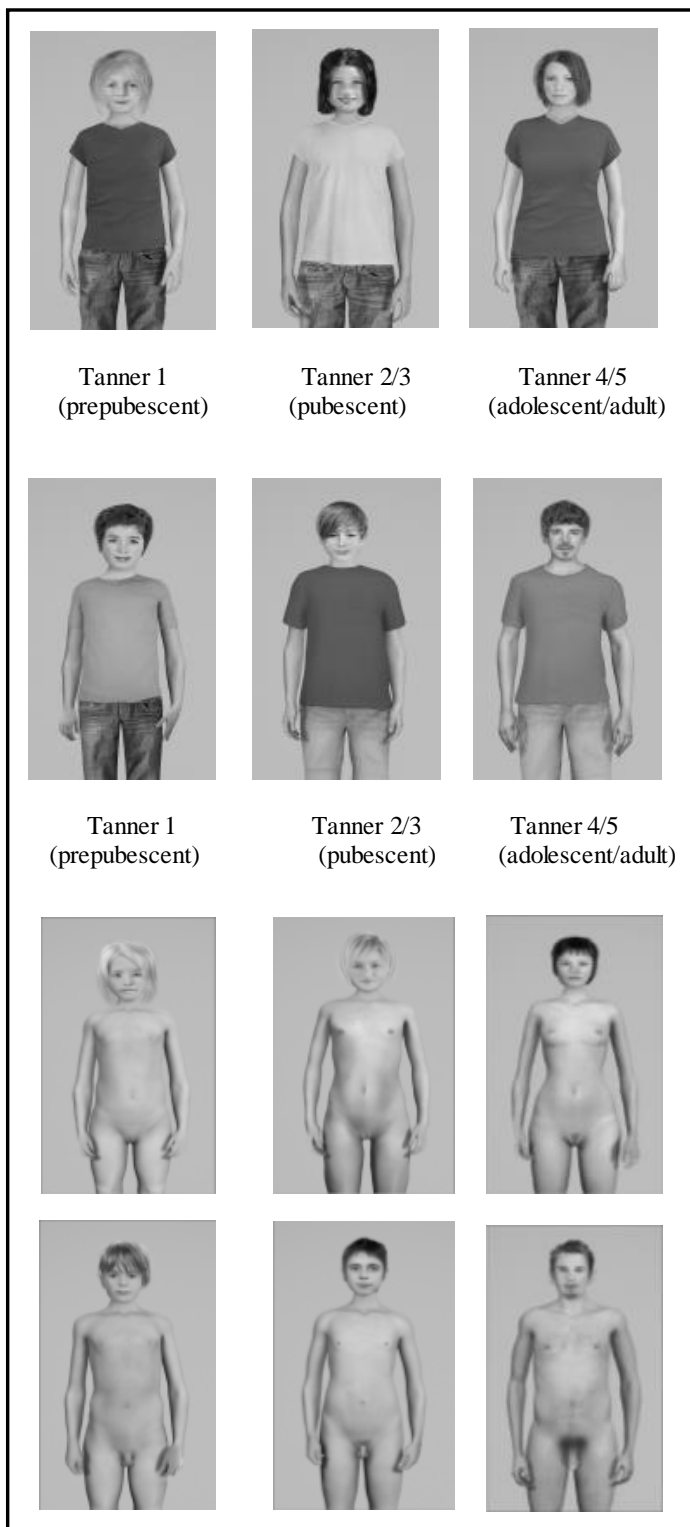
<sup>21</sup> Stimuli (photos and image from VPS) are here printed in gray scale. Original stimuli were in color.

## **Study II**

Picture stimuli were 108 images from the VPS (Dombert et al., 2013). These stimuli are computer generated images depicting both males and females varying in terms of explicitness (nude/clothed) and in terms of sexual maturity: prepubescent (Tanner 1), pubescent (Tanner 2/3) and adolescent/adult (Tanner 4/5) (following the different stages of sexual development by Tanner, 1962) (Figure 6).

## **Study III**

Picture stimuli were 54 images from the VPS (Dombert et al., 2013). These stimuli are computer-generated images depicting both nude males and females varying in terms of sexual maturity: prepubescent (Tanner 1), pubescent (Tanner 2/3) and adolescent/adult (Tanner 4/5) (following the different stages of sexual development by Tanner, 1962).



*Figure 6.* Clothed and nude female and male example images of different Tanner stages from the Virtual People Set (VPS; Dombert et al., 2013).

## 6.3 Materials and Procedure

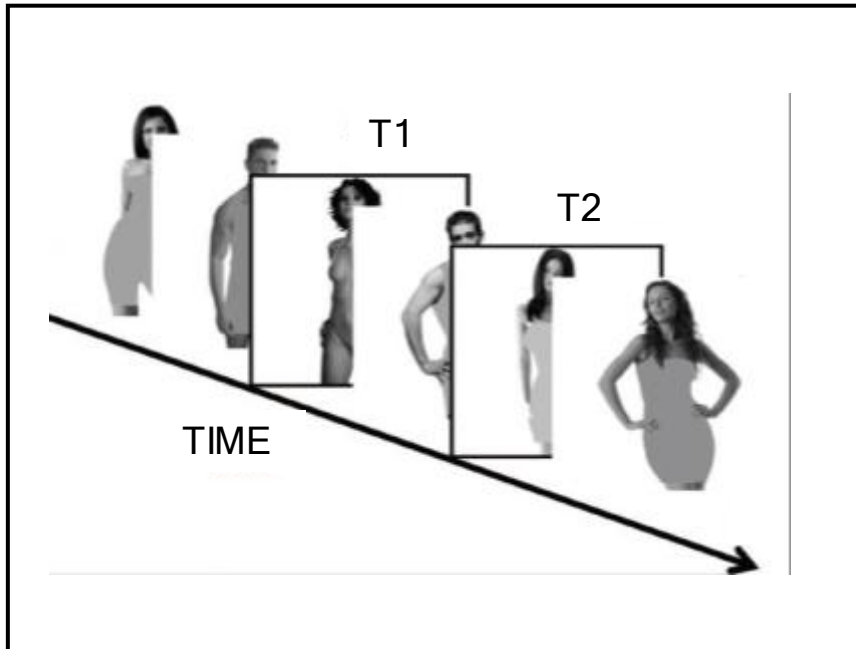
### Study I, II, III and IV

Stimulus presentation and response recording was done using Presentation® software and Apple 2.8 GHz iMac computers with 24'' LED-monitors. The dtRSVP streams were presented on a gray background. The dtRSVP stream started with a fixation cross that was presented for 1000 ms in the center of the display. The fixation cross was followed by a rapid serial presentation of 12 images. Each image was presented, on average, for 166 ms ( $SD = .24$  ms). In each trial, two of the images (T1 and T2) were framed with a black frame measuring approximately 20 x 20 cm.

Before beginning, participants were administered the BETA III Coding and Absurdities subtests (Kellogg & Morton, 1999) to make a quick assessment of their nonverbal intellectual abilities. In the Coding subtest the task involves coding symbols with numbers that are assigned to the symbols at the top of the page, while in the Absurdities subtest the task involves placing an "X" on the one picture out of four that shows something wrong or foolish. After the attention-based measurement task, participants were asked to fill out the Sell Assessment of Sexual Orientation (SASO; Sell, 1996) questionnaire and the Survey "About the Lives of Gays, Lesbians, & Bisexuals in the USSR" Questionnaire in order to assess sexual interest.

### Study I

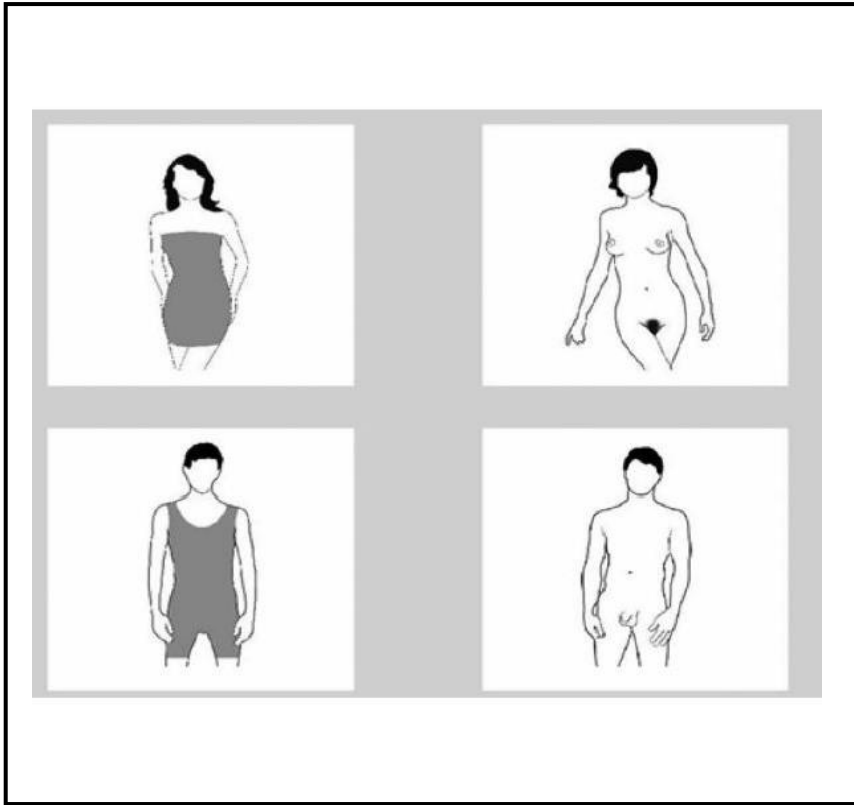
Participants were asked to try to accurately report the category (clothed/ female or clothed/nude male), of both T1 and T2 (Figure 7), and respond by pressing the corresponding key, on keypad embedded on the right side of the keyboard, recorded with the number keys (1, 3, 7 and 9), the key's position corresponding to the spatial position of the selected answer. If unsure, participants were asked to make their best guess. After the participant's response, another trial started after 1000 ms (Figure 8).



*Figure 7.* A schematic overview of the Rapid Serial Visual Presentation measurement procedure used in Study I. Twelve images were presented for 166 ms each, and T1 could appear in positions 3–9 with T2 appearing with a one-stimulus interval.

The instructions for the participants were:

You will be presented with picture series containing 12 pictures each. Two of these will be framed with a black frame. Your task is to identify what is in these framed pictures. After the picture series, you will be presented with 4 response categories, corresponding to the pictures shown. The categories are nude man, nude woman, clothed man and clothed woman. Using number keys 1, 3, 7 and 9, you are asked to report, in order, the pictures you have seen. If you don't know, we ask you to make a guess. After answering, a fixation cross will appear on the screen. Focus on that until the next trial starts. You can now do a few practice trials, during which I can answer any questions you may have.



*Figure 8.* Response alternatives presented on the screen after each trial. For both T1 and T2 responses, participants were asked to indicate the stimulus category with keys 1 for clothed male, 3 for nude male, 7 for clothed female, and 9 for nude female.

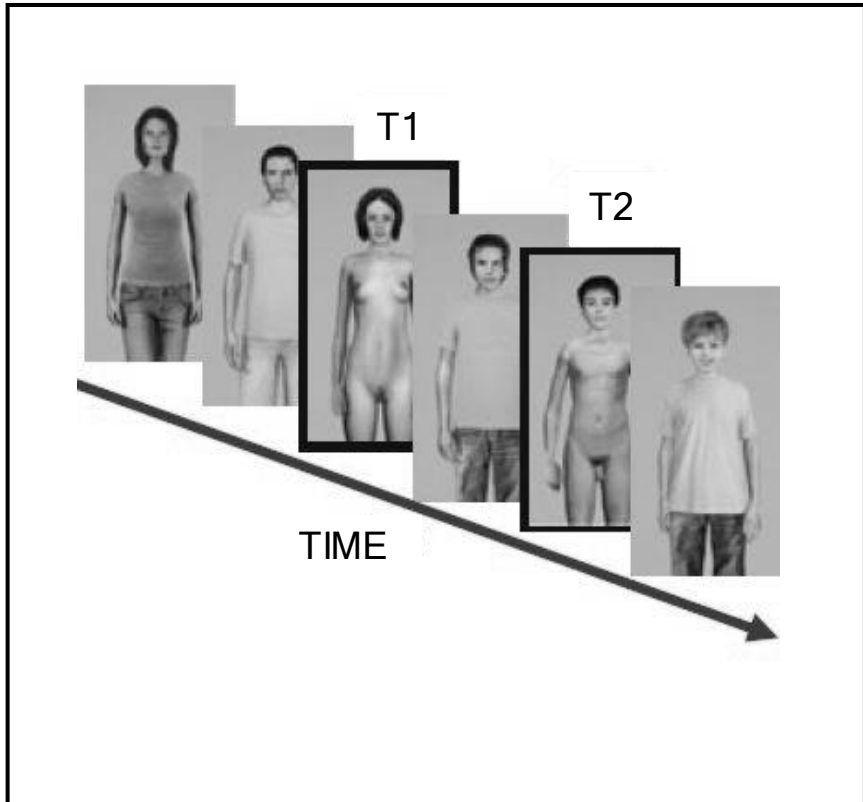
## Study II

Participants were asked to try to accurately report the category (prepubescent, Tanner 1); pubescent (Tanner 2/3) and adolescent/adult (Tanner 4/5), either clothed or nude) of both T1 and T2 (Figure 9).

The instructions for the participants were:

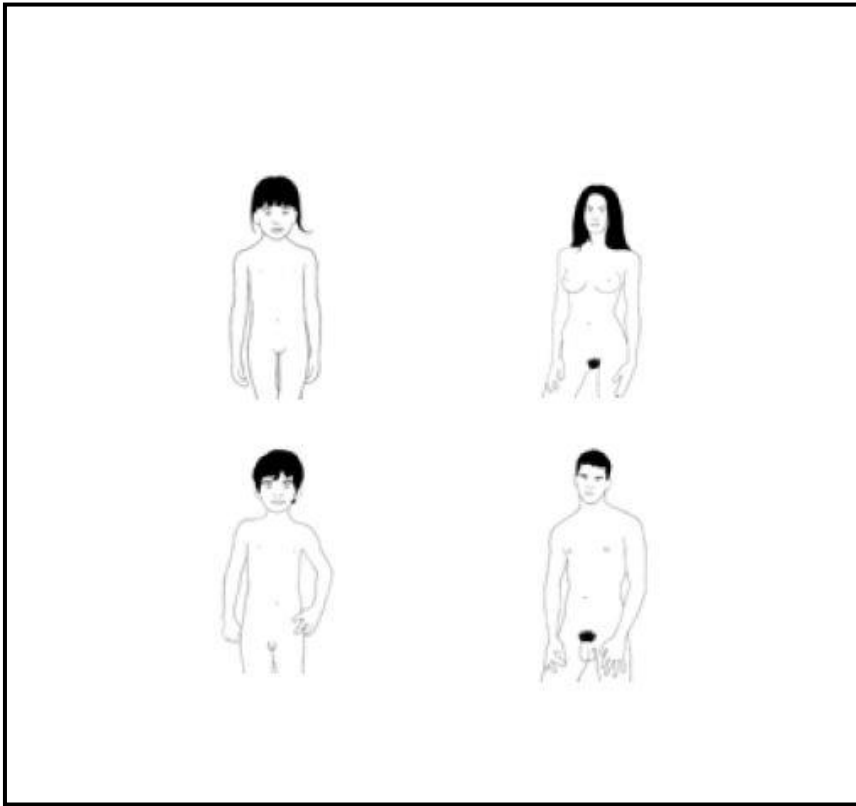
You will be presented with picture series containing 12 pictures each. Two of these will be framed with a black frame. Your task is to identify what is in these framed pictures. After the picture series, you will be presented with 4 response categories, corresponding to the pictures shown. The categories are nude child male, nude child female, nude adult male and nude clothed female. Using number keys 1, 3, 7 and 9, you are asked to report, in order, the pictures you have seen. If you don't know, we ask you to make a guess. After answering, a fixation

cross will appear on the screen. Focus on that until the next trial starts. You can now do a few practice trials, during which I can answer any questions you may have. (Figure 10).



*Figure 9.* A schematic overview of the Rapid Serial Visual Presentation measurement procedure used. Twelve images were presented for 166 ms each, and T1 could appear in positions 3–9 with T2 appearing with a one-stimulus interval.

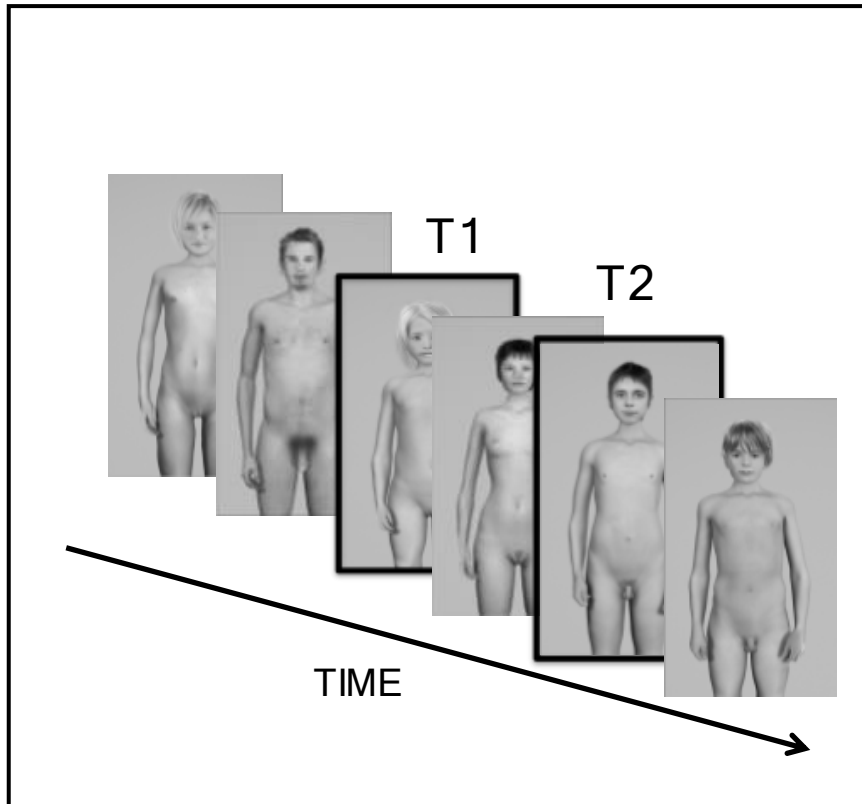




*Figure 10.* Response alternatives presented on the screen after each trial. For both T1 Stimulus and T2 Stimulus responses, participants were asked to indicate the stimulus category with keys ‘1’ for male prepubescent/pubescent (Tanner 1 and Tanner 2/3), ‘3’ for male adolescent/adult (Tanner 4/5), ‘7’ for female prepubescent/pubescent (Tanner 1 and Tanner 2/3), and ‘9’ for female adolescent/adult (Tanner 4/5).

### **Study III**

Participants were asked to try to accurately report the category (prepubescent, Tanner 1; pubescent, Tanner 2/3 and adolescent/adult, Tanner 4/5, all nude) of both T1 and T2 (Figure 11).



*Figure 11.* A schematic overview of the Rapid Serial Visual Presentation measurement procedure used. Twelve images were presented for 166 ms each, and T1 could appear in positions 3–9 with T2 appearing with a one-stimulus interval.

#### **Study IV**

In this study, we used the same procedure and stimuli as in Study I. The only exception was giving the following additional instructions to the faker group:

The hypothesis is that sexually relevant stimuli are more distracting than the non-sexually relevant stimuli. In other words, depending on what stimuli is presented the detection rate for the task is affected differently. We expect that if the first framed picture is sexually relevant the second framed picture is going to be harder to identify. Heterosexual men are expected to have a harder time identifying the second framed picture, if the first framed picture depicts a naked

adult female. Homosexual men are expected to have a harder time identifying the second framed picture, if the first framed depicts a naked adult male. Your task is to try to answer how a homosexual man would answer. In other words, when the first framed picture depicts a nude adult male, you should have difficulties answering correctly relating to the second.

## 7 Statistical Analysis

In all studies, each participant was subject to several trials and repeated measurements were collected. For each trial, the characteristics of T1 and T2 (e.g., gender, clothed or nude, maturity) and the response regarding of T1 and T2 (correct vs. not correct) chosen by the participant were collected (Figure 12).

Participant	Trial	T1 characteristics	T2 characteristics	Response T1	Response T2	Participant characteristics
1	1	T1 <sub>c</sub>	T2 <sub>c</sub>	Y <sub>11</sub>	Z <sub>11</sub>	P <sub>1</sub>
1	2	T1 <sub>c</sub>	T2 <sub>c</sub>	Y <sub>12</sub>	Z <sub>12</sub>	P <sub>1</sub>
1	j	T1 <sub>c</sub>	T2 <sub>c</sub>	Y <sub>1j</sub>	Z <sub>1j</sub>	P <sub>1</sub>
...	...	...	...	...	...	...
i	1	T1 <sub>c</sub>	T2 <sub>c</sub>	Y <sub>i1</sub>	Z <sub>i1</sub>	P <sub>i</sub>
i	2	T1 <sub>c</sub>	T2 <sub>c</sub>	Y <sub>i2</sub>	Z <sub>i2</sub>	P <sub>i</sub>
i	j	T1 <sub>c</sub>	T2 <sub>c</sub>	Y <sub>ij</sub>	Z <sub>ij</sub>	P <sub>i</sub>
...	...	...	...	...	...	...
n <sub>j</sub>	j	T1 <sub>c</sub>	T2 <sub>c</sub>	Y <sub>nj</sub>	Z <sub>nj</sub>	P <sub>n</sub>

*Figure 12.* A schematic overview of the structure of the data set.

As illustrated above, we had a data set comprised of repeated observation of two outcome variables (correctness of the response regarding to T1 and T2) and a set of covariates for each participant. Our objective, in analyzing our data set, was to describe the marginal expectation of the two outcome variables as a function of the predictor variables (e.g., sexual interest of the participants).

The analysis of data from these types of studies requires special techniques that take into account the fact that on several occasions repeated measures on the same individual tend to be correlated. Auto-correlated data are observations that are not independent of each other but are related to some or to all observations. The statistical techniques that assume independence of observations, such as linear regression and the logistic regression, cannot be used directly because they do not take into account the fact that the repeated observations of each individual may be related. The general idea behind the analysis of these types of data is that a correction is made for intra-subject correlations. In light of this, we used Generalized Estimation Equations (GEE, developed by Zeger & Liang, 1986). GEE

can be used to analyze continuous and discrete data, which gives consistent estimators of the regression coefficients and of their variances under weak assumption regarding the actual correlation among a participant's observations.

GEE analysis consists of four phases: 1) assuming that the observations within participants are independent, a naive linear regression analysis is carried out (e.g., looks for a linear correlation between the accuracy in reporting T1, the gender of T1 and sexual interest of the participant ignoring the correlation between participants); 2) residuals are calculated from the naive model (observed-predicted) and a working correlation matrix is estimated from these residuals<sup>22</sup>; 3) by an iterative process, the regression coefficients are refit, correcting for the correlation; 4) the within-participant correlation structure is treated as a nuisance variable (i.e., as a covariate).

In **all studies**, we used the GEE procedure to analyze: a) Pop Out effect on T1 and T2, calculating the differences in accuracy in reporting T1 and T2; b) the AB phenomenon, selecting only the trials when the T1 was correctly reported (i.e., if the response category was the same as the actual stimulus category) and calculating the T2 accuracy.

In **all studies**, in order to test the measurement performance we used a receiver operating characteristic (ROC) curve analysis (e.g. Zou, O'Malley, & Mauri, 2007) to determine the trade-off between sensitivity (fraction of true positives) and lack of specificity (i.e., the fraction of false positives or false alarms) of the test using the responses of the participants as a method of assigning them to a sexual preference group. True positives are participants whose sexual preference is correctly predicted whereas the term false positive here denotes cases whose sexual preference is falsely predicted. The area under the ROC curve (AUC) is as measure of a diagnostic test's discriminatory power. AUC value varies between 0 and 1. AUC equals 0.5 when the ROC curve corresponds to random chance and 1.0 for perfect accuracy.

To perform the ROC analyses, a few indices were created to be used as the test variable. The detailed description of the indices, for each study, is explained below,

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<sup>22</sup> The correction for within participants correlations is carried out by assuming *a priori* a correlation structure for the repeated measurements, however GEE is robust against a wrong choice of correlation matrix—overmost particularly with large sample size.

however, it should be noted that the predictors were indices that indicated the Pop Out effect, the Attentional Blink.

The Pop Out indices represented the accuracy in the reporting of T1 (T2) as a function of whether T1 (T2) was sexually preferred. The AB indices represented the accuracy in the reporting of T2 when T1 was sexually preferred and was accurately reported.

For example, in Study I (which purpose was to differentiate sexual preference in men), Pop Out Index 1 was calculated by subtracting the proportion of correctly identified male T1 from female T1, whereas Pop Out Index 2 was calculated by subtracting the proportion of correctly identified male T2 from female T2. The AB index was calculated by subtracting the proportion of correctly identified T2 when T1 was a female, from T2 when T1 was a male. The indices were hypothesized to be positive for heterosexual men and negative for homosexual men. The indices were subjected to a logistic binary regression with sexual preference (homosexual men vs. heterosexual men) as the dependent variable. The obtained probabilities (total index) from this regression analysis were then used as the test variable in an ROC-curve analysis.

## 7.1 Study I

For all statistical analyses SPSS 19.0 was used. We had 4 stimulus categories (2 [Gender] X 2 [explicitness]) and four response categories (2 [Gender] X 2 [explicitness]). As the presentation of clothed and nude stimuli could not be fully factorial, we collapsed this into two gender stimuli categories (male and female). Responses were coded as correct if the response category was the same as the actual stimulus category, and wrong if differing from the actual stimulus category. After the experiment, participants completed the Sell Assessment of Sexual Orientation (SASO; Sell, 1996) questionnaire, which uses self-stated interest in men and women in order to assess sexual preference. The items describing homosexual men and heterosexual men preference were transformed into an ordinal scale, with the answers to “I consider myself” ranging from 0 “not at all homosexual/heterosexual men” to 7 “Extremely homosexual/heterosexual men”. By subtracting the value of

the item regarding heterosexual men interest from the value of the item regarding homosexual interest, we obtained an index of sexual preference ranging from -7 to 7.

#### *Discriminatory effectiveness using Pop Out effect*

In order to assess the ability of this measurement to differentiate between the groups of homosexual men and heterosexual men we calculated three indices based on the hypothesized differences in T1 and T2 accuracy. We subtracted the proportion of correctly identified male T1 from female T1 (T1 index), male T2 from female T2 (T2 index), and T2 when T1 was a female from T2 when T1 was a male (AB index). Thus, all indices were hypothesized to be positive for heterosexual men and negative for homosexual men. The indices were subjected to a logistic binary regression with sexual preference (homosexual men vs. heterosexual men) as the dependent variable. The obtained probabilities (total index) from this regression analysis were then used as the test variable in an ROC-curve analysis. Finally, we correlated the sexual preference index with the outcome indices from the dtRSVP measure to explore how much of the between-participant variability in the responses that was due to real-life sexual preference.

## 7.2 Study II

SPSS 17.0 was used for all statistical analyses. Responses were coded as correct if the response category was the same as the actual stimulus category, and erroneous if differing from the actual stimulus category. We had 12 stimulus categories (2 [Gender] X 2 [explicitness] X 3 [Tanner categories]) and four response categories (2 [Gender] X 2 [Tanner categories T 4/5 vs. T1 and T 2/3 grouped]).

#### *Discriminatory effectiveness using Pop Out effect*

The GEE analysis showed that homosexual men had a higher accuracy than heterosexual men in the reporting of T1/T2 when T1/T2 was a male, and that heterosexual men had a higher accuracy in the reporting of T1/T2 when T1/T2 was a female. We calculated two indices. Subtracting the percentage of T1/T2 accuracy when T1/T2 is a male T1/T2 from the percentage of T1/T2 accuracy when T1/T2 is

female should thus yield a positive index for the homosexual men, and, vice versa, a negative index for the heterosexual men.

An ROC curve analysis was conducted in order to determine the trade-off between sensitivity and lack of specificity of the test. True positives are participants whose sexual preference is correctly predicted (homosexual or heterosexual). The predictor used in these ROC analyses was an index that represented the accuracy in the reporting of T1/T2 as a function of whether T1/T2 was male or female when we considered only T1/T2 Tanner 4/5 stimuli. The area under the curve (AUC) measure indicates how likely a randomly picked homosexual participant would have a higher value on this index, in comparison with a randomly picked heterosexual participant. A third overall index was calculated combining both the T1 and T2 Pop Out indices. The two indices were subjected to a logistic binary regression with sexual preference (homosexual vs. heterosexual) as the dependent variable. The obtained probabilities from these regression analyses were then used as the test variable in an ROC-curve analysis.

### 7.3 Study III

SPSS 17.0 was used for all statistical analyses. Responses were coded as correct if the response category was the same as the actual stimulus category, and erroneous if differing from the actual stimulus category. We had 6 stimulus categories (2 [gender] X 3 [Tanner categories<sup>23</sup>]) and four response categories (2 [gender] X 2 [Tanner categories, Tanner 4/5 vs. Tanner 1 and Tanner 2/3 grouped]).

Combining information from both the participants' assumed sexual preferences and the gender and Tanner category of the stimuli, we created three new dichotomous variables: (1) Preferred Gender: This variable was set to 1 if the gender of the stimulus was male and the sexual interest of the participant was homosexual men or if the gender of the stimulus was female and the sexual interest of the participant was heterosexual men. In all other cases Preferred Gender was set to 0. (2) Preferred Maturity Level: This variable was set to 1 if the Tanner category of the stimulus was 1 (i.e. prepubescent) and the participant belonged to the Child Sex

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<sup>23</sup> Tanner 1, Tanner 2 and 3 grouped, and Tanner 4 and 5 grouped.



Offender (CSO) group or if the Tanner category of the stimulus was 4/5 (i.e. adolescent/adult) and the participant did not belong to CSO group. A participant was defined as homosexual if the participant committed a sex offence against a male child (age below under 12 years old), or if the participant was assessed as a homosexual man through SASO questionnaire. Finally, a dichotomous variable named Pedophile Preferred was set to 1 if the maturity level of the stimulus belonged to Tanner 1 category and the participant had an SSPI<sup>24</sup> value greater than 2.

In analyzing the AB, following early studies, we selected only the trials where the T1 was correctly reported (i.e., if the response category was the same as the actual stimulus category) and calculated the T2 accuracy as a function of the type of T1.

#### *Discriminatory effectiveness using Pop Out effect*

The GEE analysis showed that when T1 and T2 were of preferred gender and preferred maturity level, the accuracy in reporting them was higher in comparison to when they were not. We calculated two Pop Out indices and an AB index. Pop Out Index 1 was calculated subtracting the percentage of T1 accuracy when it was of preferred gender and the maturity level was Tanner 1, from T1 accuracy when it was of preferred gender and the maturity level was Tanner 4/5 which should yield a positive index for pedophilic men, and, vice versa, a negative index for non-pedophilic men. Pop Out Index 2 was calculated in the same way as Pop Out Index 1 considering T2. AB index was calculated subtracting the percentage of T2 accuracy when correctly reported T1 were of preferred gender and the maturity level was Tanner 1, from T2 accuracy when correctly reported T1 were of preferred gender and the maturity level was Tanner 4/5 which should yield a negative index for the pedophiles, and, vice versa, a positive index for non-pedophiles. Next, an ROC curve analysis was conducted in order to determine the trade-off between sensitivity and specificity. These analyses were limited to differentiating between a more

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<sup>24</sup> The Screening Scale for Pedophilic Interests (SSPI; Seto, Lalumière, 2001), is a brief measure of sexual attraction to prepubescent children that is based on victim characteristics. Value 0 means no interest, value 5 maximum interest.

strictly defined pedophile group (i.e., in this group containing only participant scored an SSPI value greater than 2) and a group consisting of other participants, as a significant AB effect was only found when this division was used.

True positives are participants whose sexual interest is correctly predicted (pedophile or non-pedophile). The predictors used in these ROC analyses were Pop Out Index 1, Pop Out Index 2 and AB Index. A fourth overall index was calculated combining Pop Out Index 1, Pop Out Index 2 and AB Index. To do this, the three indices were subjected to a logistic binary regression with sexual interest (pedophile vs. non-pedophile) as the dependent variable. The obtained probabilities from these regression analyses were then used as the test variable in an ROC-curve analysis. The AUC measure indicates how likely a randomly picked pedophile participant would have a higher value on this index compared to a randomly picked non-pedophile participant.

## 7.4 Study IV

SPSS 17.0 was used for all statistical analyses. We had 4 stimulus categories (2 [Gender] X 2[explicitness]) and four response categories (2 [Gender] X 2 [explicitness]). Responses were coded as correct if the response category was the same as the actual stimulus category, and erroneous if differing from the actual stimulus category.

### *Discriminatory effectiveness using AB*

The GEE analysis showed that the accuracy in reporting T2 is higher in faker group than homosexual group and that the accuracy in reporting T2 is higher in faker group than straight group.

An ROC curve analysis was conducted in order to determine the trade-off between sensitivity (fraction of true positives) and lack of specificity (i.e., the fraction of false positives or false alarms) of the test. True positives are participants whose sexual preference is correctly predicted (heterosexual or faker; homosexual or faker; faker or non-faker), whereas the term “false positives” here denotes cases whose sexual preference is falsely predicted.

The AUC measure indicates how likely a randomly picked homosexual (or heterosexual) participant has a more correct reporting of T2 than a randomly picked faker participant. We conducted 5 ROC analyses using different predictor variables.

To discriminate between the homosexual group and the faker group we used as a predictor a variable index that represent the difference between percentage of T2 accuracy after nude male T1 and the percentage of T2 accuracy after clothed female T1.

To discriminate between the heterosexual group and the faker group we used as a predictor a variable index that represent the difference between percentage of T2 accuracy after nude female T1 and the percentage of T2 accuracy after clothed male T1.

We conducted an ROC analysis to discriminate faker vs. non-faker (homosexual and heterosexual grouped) using as a predictor a variable index that represent the difference between percentage of T2 accuracy after nude female T1 and the percentage of T2 accuracy after clothed male T1.

We conducted an ROC curve analysis to discriminate between the homosexual group and the faker group using as a predictor a variable index that represent the difference between percentage of T2 accuracy after nude male T1 and the percentage of T2 accuracy after clothed female T1.

Finally, we conducted an ROC analysis using as predictor a variable index that represents the difference between the percentage of T2 accuracy after nude female T1 from the percentage of T2 accuracy after clothed male T1.

## 8 ETHICAL CONSIDERATIONS

In all four studies the participants were volunteers. In our data set, participants remained anonymous to the researchers. The ethics review committee of the Medical School at the University of Regensburg in Germany gave their ethical approval for the studies.

## 9 STUDY I: real-life sexual preference moderated information processing of sexually relevant stimuli in a dtRSVP procedure

### 9.1 Resume

In Study I we investigated if and how real-life sexual preference moderated information processing of sexually relevant photos of men and women (clothed and nude) presented as a target one (T1) and a subsequent target two (T2) in a dtRSVP.

The participants were a group of homosexual ( $n = 17$ ) and a group of heterosexual men ( $n = 18$ ). 480 photos of actual men and women (nude and clothed) were used as stimuli.

### 9.2 Hypotheses

- 1) We expected that the amount of correctly identified T1 would increase if T1 was a sexually preferred image compared to when T1 was a non-preferred image (due to Pop Out effect).
- 2) We expected that the correct identification of a T2 would decrease following sexually preferred T1 compared to non-preferred T1 (due to AB).
- 3) We expected that the correct identification of a T2 would increase if T2 was a sexually preferred image compared to when T2 was a non-preferred image (due to Pop Out effect).

### 9.3 Results

#### **Hypothesis 1 received support**

We found an increase in T1 accuracy when T1 was a sexually preferred image compared to when T1 was not a sexually preferred image. Homosexual men had an increased T1 accuracy when T1 was male compared to when T1 was female and heterosexual men had an increased T1 accuracy when T1 was female compared to

when if T1 was male. There was a significant interaction between T1-gender (male vs. female) and sexual orientation (homosexual men vs. heterosexual men) and it was in the hypothesized direction as both groups more correctly identified sexually preferred T1 images compared to non-preferred images. Planned comparisons revealed that for homosexual men the difference in T1-accuracy as a function of T1 gender was significant. Homosexual men identified more male T1 than female T1. For heterosexual men a similar planned comparison revealed a significant effect so that heterosexual men correctly identified more female T1 than male T1 (Figure 13).

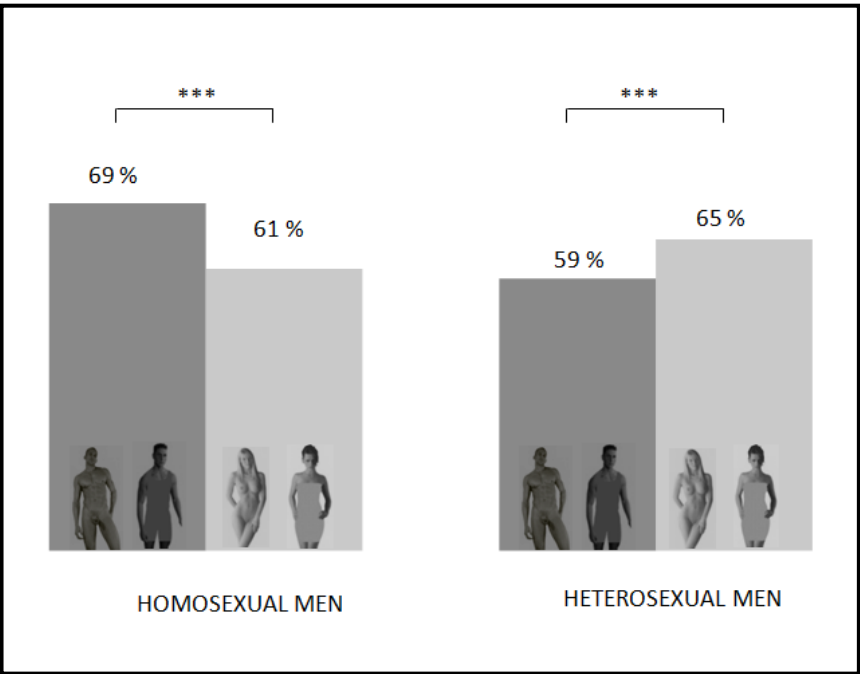


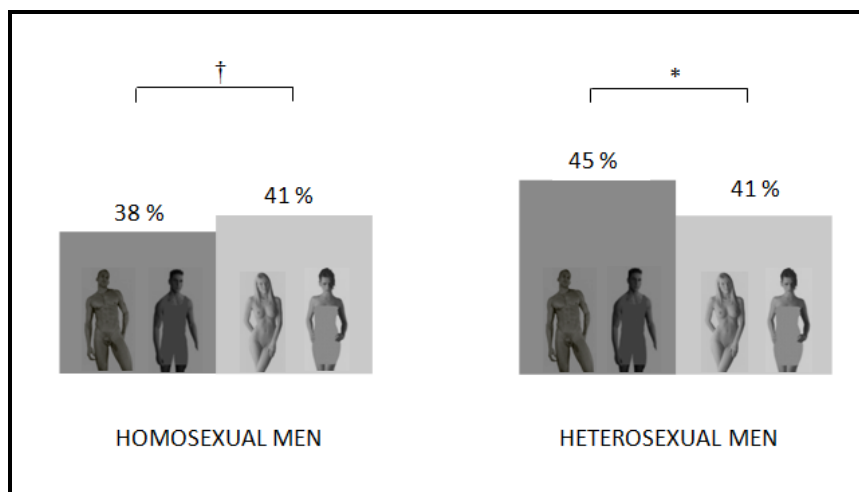
Figure 13. Detection rates of T1 stimuli in the homosexual and heterosexual group.

**Hypothesis 2 received support**

We found a decrease in the correct identification of T2 when T1 was a sexually preferred image compared to when T1 was not sexually preferred. We found that homosexual men had decreased T2 accuracy when T1 was male compared to when T1 was female, and heterosexual men had decreased T2 accuracy when T1 was female compared to when T1 was male. We found an interaction between sexual orientation

(homosexual men vs. heterosexual men) and T1 gender (male vs. female). In both groups (homosexual men vs. heterosexual men) T2 accuracy was decreased following sexually preferred stimuli compared to non-preferred stimuli (Figure 14).

Findings indicated that for homosexual men there was a tendency so that T2 accuracy was decreased following male compared to female T1. For heterosexual men the difference in T2 accuracy as a function of T1 gender was significant and in the expected direction, as T2 accuracy was decreased following female T1 compared to male T1. There were no main effects of sexual preference or T1 gender.



*Figure 14.* Detection rates of T2 stimuli when T1 was correctly reported in the homosexual and heterosexual men group (the pictures in the box, i.e., male nude and clothed and the female nude and clothed, represent the type of T1).

### **Hypothesis 3 received support**

We found an increase in T2 accuracy when T2 was a sexually preferred image compared to when T2 was not a sexually preferred image. Homosexual men had an increased T2 accuracy when T2 was male compared to when T2 was female and heterosexual men had an increased T2 accuracy when T2 was female compared to when T2 was male. There was a significant interaction between T2 gender (male vs. female) and sexual orientation (homosexual men vs. heterosexual men) and it was in the hypothesized direction as both groups more correctly identified sexually preferred T2 images compared to non-preferred images. Planned comparisons revealed that for

homosexual men the difference in T2 accuracy as a function of T2 gender was significant. Homosexual men identified more male T2 than female T2. For heterosexual men a similar planned comparison revealed a tendency so that heterosexual men correctly identified more female T2 than male T2 (Figure 15).

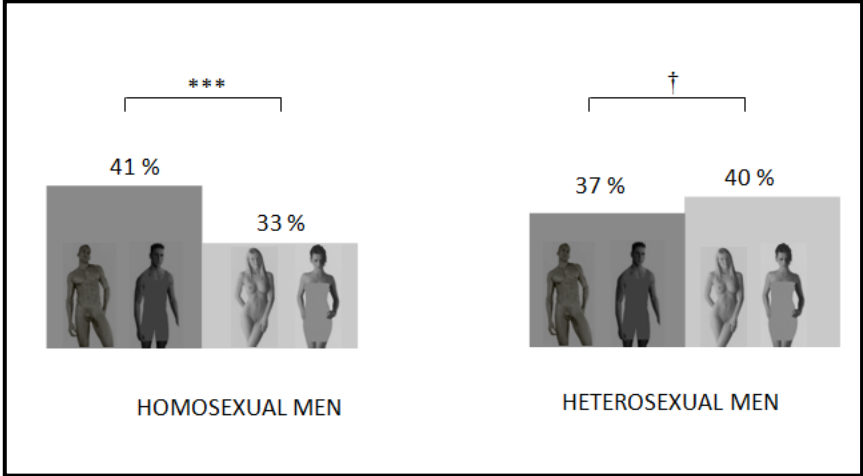


Figure 14. Detection rates of T2 stimuli in homosexual and heterosexual group (the pictures in the box, i.e., male nude and clothed and the female nude and clothed, represent the type of T1).

*Discriminatory effectiveness using Pop Out effect*

We obtained a high separation between homosexual male and heterosexual male participants ( $AUC = .88, p < .001$ ). We found that a continuous measure of sexual preference for men vs. women (an ordinal measurement that varied from -7 to 7 obtained from the items measuring sexual preference [homosexual or heterosexual] in the Sell Assessment Orientation questionnaire) moderated the detection rates of sexual stimuli in the dtRSVP.

9.4 Conclusions

Our hypotheses received supported by findings. Detailed analysis of diagnostic properties (ROC analysis) showed a high separation between homosexual male and heterosexual male participants.



## 10 STUDY II: dtRSVP can be used to separate between heterosexual and homosexual interest in men using different Tanner stages images from Virtual People Set

### 10.1 Resume

In this study, we investigated if and how sexually relevant visual stimuli affect information processing of both a target one (T1) and a subsequent target two (T2) in a dtRSVP when used as an attention-based measurement procedure of sexual preference. The participants were a group of homosexual ( $n = 13$ ) and a group of heterosexual men ( $n = 13$ ). 108 images from VPS (Dombert et al., 2013) depicting both males and females varying in terms of explicitness (nude/clothed) and in terms of sexual maturity: prepubescent (Tanner 1), pubescent (Tanner 2/3) and adolescent/adult (Tanner 4/5) were used as stimuli.

### 10.2 Hypotheses

- 1) We expected that the correct identification of T2 would have been decreased following a sexually preferred T1 compared to a non-preferred T1 (due to AB).
- 2) We expected that the proportion of correctly identified T1/T2 would have been increased if they represented an adolescent/adult image (Tanner 4/5) compared to prepubescent/pubescent image (i.e., Tanner 2/3 or Tanner 1) (due to Pop Out effect).
- 3) We expected an interaction between T1/T2 gender (female vs. male) and group (homosexual vs. heterosexual) when the T1/T2 was an image of an adolescent/adult (Tanner 4/5). In this case, we expected homosexual participants to be better at detecting a male T1/T2 (vs. female T1/T2) and heterosexual participants to be better at detecting a female T1/T2 (vs. male T1/T2) (due to Pop Out effect).
- 4) We expected an effect of stimulus explicitness (nude vs. clothed) when the T1/T2 was adolescent/adult (Tanner 4/5) with better detection of nude stimuli (due to Pop Out effect).

- 5) We expected to find (a) a three-way interaction between T1/T2 gender (female vs. male) X group (homosexual vs. heterosexual) X T1/T2 Tanner-stage on the detection of T1/T2 when images from all Tanner categories were included in the analyses. In this case we expected to find that the detection rates would be higher for the Tanner 4/5 (vs. Tanner 1 and Tanner 2/3) stimuli and also that, homosexual participants would have higher detection rate for the male (vs. female) stimuli and the heterosexual participants for the female (vs. male) stimuli when we considered only Tanner 4/5 stimuli. (b) We further expected to find an interaction between group (homosexual vs. heterosexual) X T1/T2 gender (female vs. male) X T1/T2 Tanner-stage X T1/T2 explicitness (nude or clothed) on the detection of T1/T2 so that the above-described in hypothesis 5 (a) effect would be stronger in the nude condition (due to Pop Out effect).

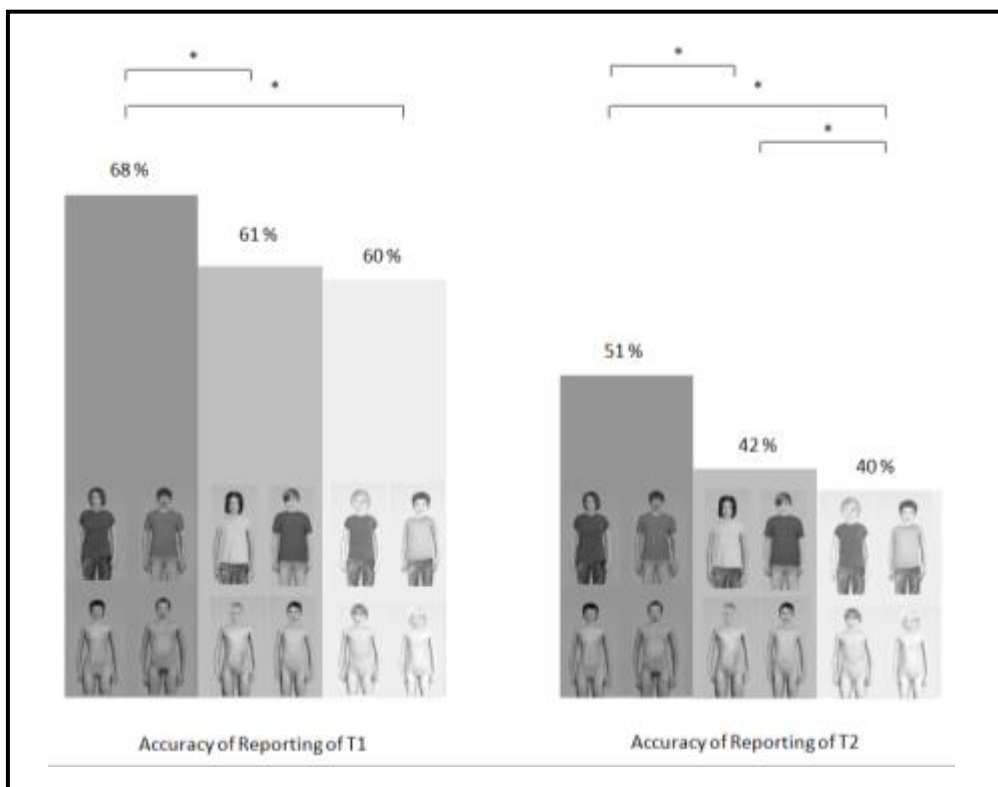
### 10.3 Results

#### **Hypothesis 1 did not receive support**

We did not find that a correct identification of a T2 was decreased following a sexually preferred (vs. non-preferred) T1.

#### **Hypothesis 2 received support**

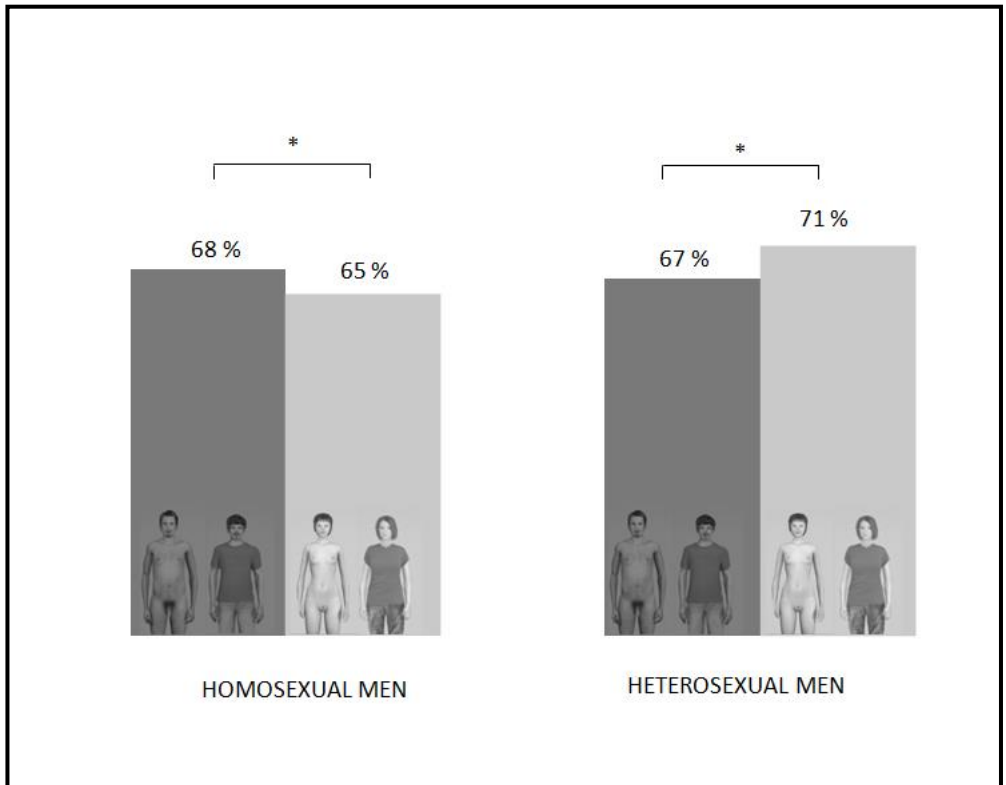
The proportion of correctly identified T1 was increased if T1 was an adolescent/adult (Tanner 4/5) image compared to when T1 was a pubescent (Tanner 2/3) or pre-pubescent (Tanner 1) image. The proportion of correctly identified T2 was increased if T2 was an adolescent/adult (Tanner 4/5) image compared to when T2 was a pubescent (Tanner 2/3) or a prepubescent image (Tanner 1) (Figure 16).



*Figure 16.* Detection rates of T1 and T2 stimuli and stimulus category of stimuli.

### **Hypothesis 3 received support**

We found an interaction between T1 gender (female vs. male) X group (homosexual vs. heterosexual) if we selected only the T1 Tanner 4/5 stimuli. We found that homosexual participants were better at detecting a male T1 vs. female and heterosexual participants were better at detecting a female T1 vs. male (Figure 17).



*Figure 17.* Detection rates of T1 in homosexual and heterosexual group.

We also found an interaction between T2 gender X group (homosexual vs. heterosexual) if we selected only the T2 Tanner 4/5. We found that homosexual participants were better at detecting a male T2 vs. female T2 and heterosexual participants were better at detecting a female T2 vs. male T2 (Figure 18).

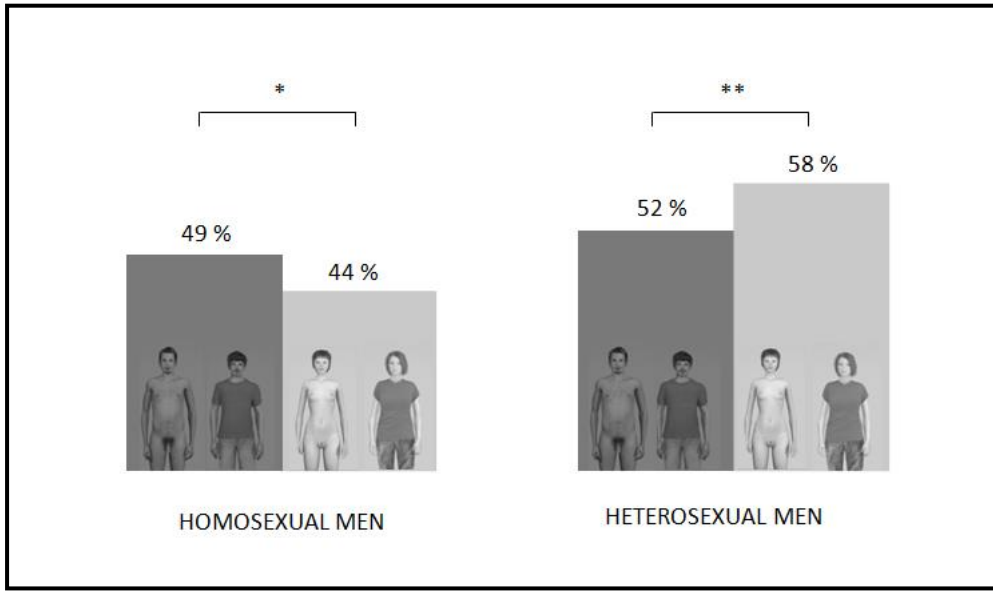


Figure 18. Detection rates of T2 in homosexual and heterosexual group.

#### *Discriminatory effectiveness using Pop Out effect*

We obtained a good separation between homosexual and heterosexual group ( $AUC = .85, p < .001$ ).

#### **Hypothesis 4 received support**

The proportion of correctly identified T1 was increased if T1 was a nude image compared to when T1 was a clothed image. The proportion of correctly identified T2 was increased if T2 was a nude image compared to when T2 was a clothed image (Figure 19).

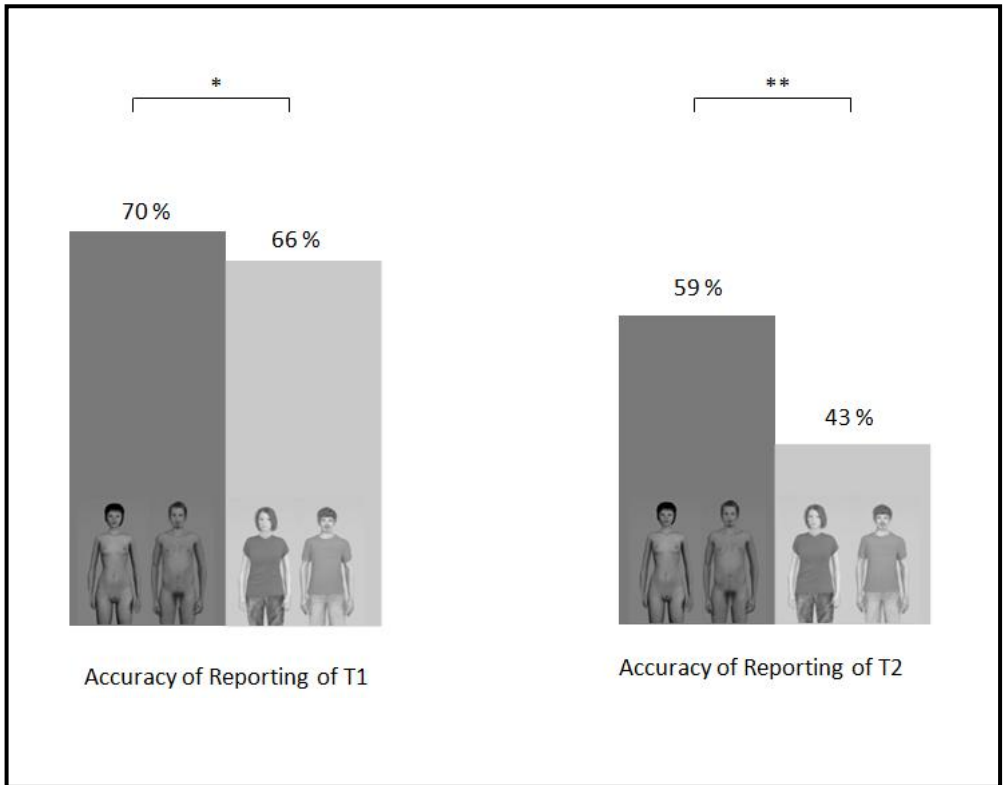


Figure 19. Detection rates of T1 and T2 and stimulus category of stimuli.

**Hypothesis 5 (a) received support. Hypothesis 5 (b) did not receive support**

(a) We found a group (homosexual vs. heterosexual) X T1 gender (male vs. female) X T1 Tanner stage interaction on the detection of T1. We also found a group (homosexual vs. heterosexual) X T2 Gender (male, female) X T2 Tanner-stage interaction on the detection of T2. In both cases, the detection rates were higher for the Tanner-stage 4/5 (vs. Tanner-stage 1 and 2/3) stimuli and, also, homosexual participants had higher detection rates for the male (vs. female) stimuli and the heterosexual participants for the female (vs. male) stimuli for the Tanner-stage 4/5 stimuli.

(b) We did not find a group (homosexual vs. heterosexual) X T1 gender (male vs. female) X T1 Tanner-stage X T1 explicitness (nude or clothed) interaction on the detection of T1. We also did not find a group (homosexual vs. heterosexual) X

T2 gender (male vs. female) X T2 Tanner X T2 explicitness (nude vs. clothed) interaction on the detection of T2.

## 10.4 Conclusions

Not all our hypotheses received support by the findings, however, detailed analysis of diagnostic properties (ROC analysis) showed a high separation between homosexual and heterosexual participants.

## 11 STUDY III: dtRSVP can be used to identify deviant and non-deviant sexual preferences in men

### 11.1 Resume

In this study, we investigated if and how sexually relevant visual stimuli affect information processing of both a target one (T1) and a subsequent target two (T2) in a dtRSVP when used as an attention-based measurement procedure of deviant sexual preference. The participants consisted of Child Sex Offenders ( $n = 69$ ), other sex offenders ( $n = 43$ ), non-sex offenders ( $n = 14$ ), and Community Controls ( $n = 88$ ) recruited in Finland, Germany, and Italy. 54 images from VPS (Dombert et al., 2013) depicting both males and females varying in terms of explicitness (nude/clothed) and in terms of sexual maturity: prepubescent (Tanner 1), pubescent (Tanner 2/3) and adolescent/adult (Tanner 4/5) were used as stimuli. All stimuli were nude in the present study.

### 11.2 Hypotheses

- 1) We expected a Pop Out effect on T1 and T2 (i.e., the accuracy in reporting T1 and T2 would be relatively increased when these were of preferred gender and preferred maturity level compared to when they were not);
- 2) We expected an AB on the accuracy in reporting T2 (i.e. when correctly reported T1 were of preferred gender and maturity level the accuracy in reporting T2 would decrease in comparison to when T1 were not preferred).

### 11.3 Results

#### **Hypothesis1 received support**

We found a T1 Preferred Gender X T1 Preferred Maturity Level interaction. We found that when T1 was of Preferred Gender and Pedophile Preferred (pedophile vs. non-pedophile), the accuracy in reporting T1 was higher in comparison to when it was not (Figure 20).



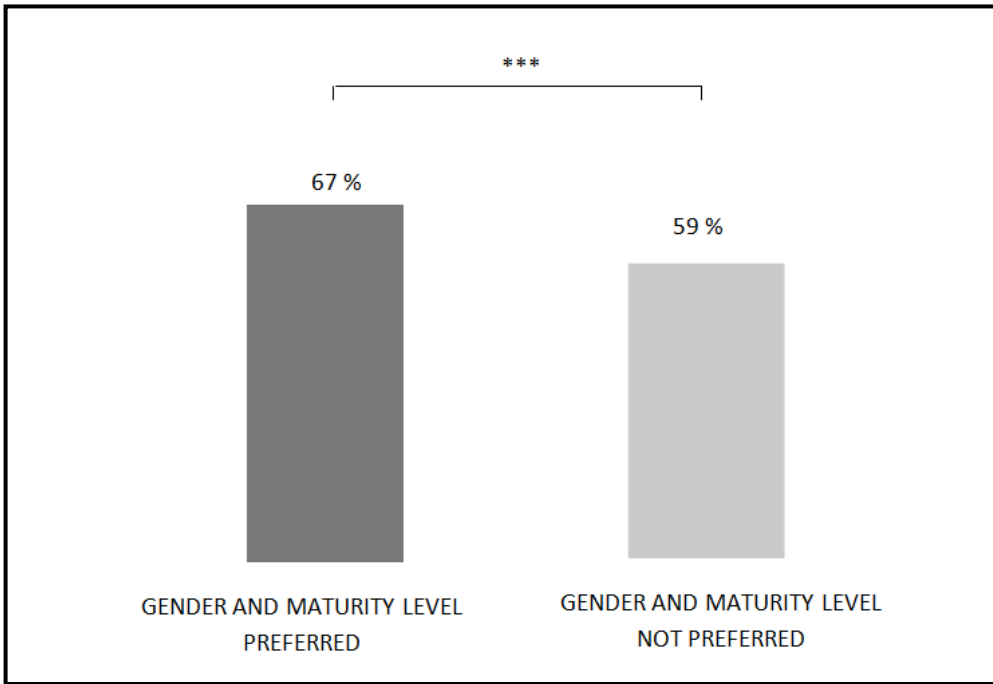
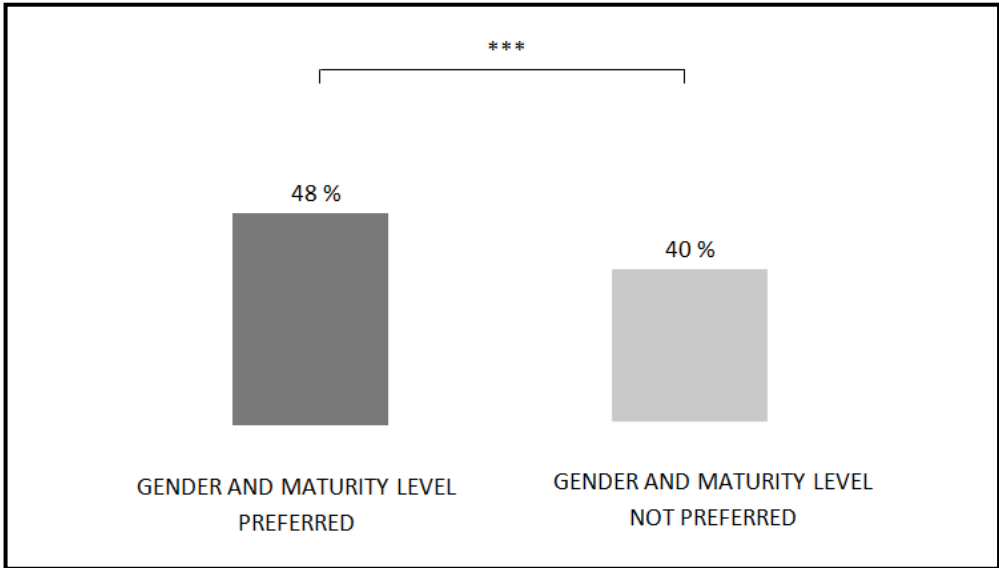


Figure 20. Detection rates of T1.

We also found a T2 Preferred Gender X T2 Preferred Maturity Level interaction. When T2 were of Preferred Gender and Pedophile Preferred (pedophile vs. non-pedophile) the accuracy in reporting them was higher in comparison to when they were not (Figure 21).



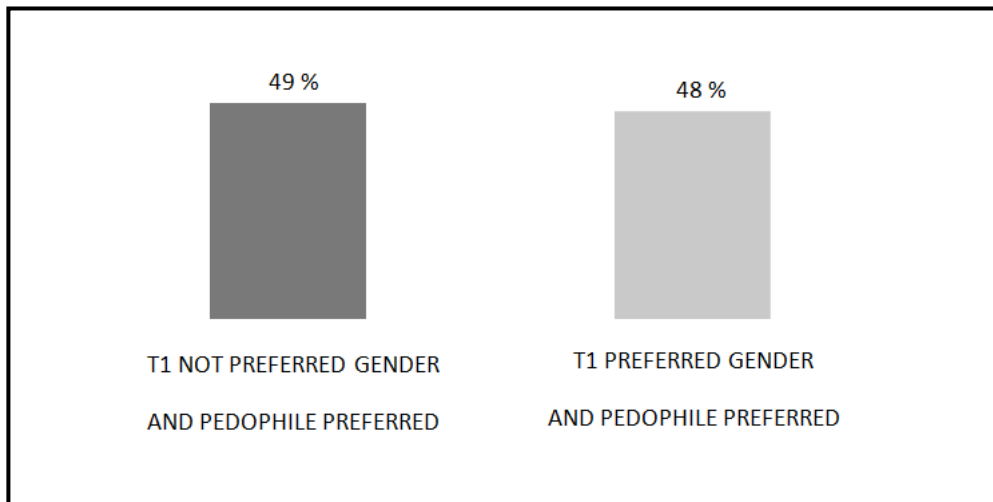
*Figure 21.* Detection rates of T2.

### **Hypothesis 2 was partly supported**

We did not find an interaction between T1 preferred gender and preferred maturity level on the accuracy in reporting T2. However, we found an interaction between T1 Preferred Gender and Pedophile Preferred<sup>25</sup> and the means of accuracy in reporting T2 went in the expected direction with the highest detection rate for T2 being observed when the T1 was neither of the preferred gender nor of the preferred maturity level. However, the difference in the detection rate to the situation where the T1 was of preferred gender and maturity level was not significant and the interaction was mostly due to the detection rate of T2 being the lowest when the T1 was of the not preferred gender but of the preferred maturity level (Figure 22).

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<sup>25</sup> We defined a dichotomous variable, Pedophile Preferred, that was set to 1 if the maturity level of the stimulus belonged to Tanner 1 category and the participant had a value greater than 2 at the Screening Scale for Pedophilic Interests.



*Figure 22.* Detection rates of T2 when T1 was accurately reported.

#### 11.4 Conclusions

We found some evidence for a Pop Out effect for preferred gender and maturity stimuli emerged. We did not find AB. Attempts to create indices of Pop Out accuracy for preferred gender and maturity that covaried with pedophilia yielded ROC-AUC accuracies that, although significant, were at best marginal and not sufficient to allow diagnostic differentiation among groups.

## 12 STUDY IV: Testing the fakeability of dtRSVP as an attention-based measurement procedure of sexual preference

### 12.1 Resume

In this study, we investigated the fakeability of the dtRSVP when used as an attention-based measurement procedure of sexual preference. The participants were a group of homosexual men ( $n = 8$ ), a group of heterosexual men ( $n = 8$ ), and heterosexual men instructed to fake their T2 responses, adopting the expected response style of homosexual men when the T1 and T2 stimuli were pictures of nude and clothed men and women ( $n = 12$ ). 480 photos of men and women (nude and clothed) were used as stimuli.

### 12.2 Hypotheses

- 1) We expected the faker group to report T2 more accurately compared to both the homosexual men and the heterosexual men groups when T1 was correctly reported (due to the cognitive load of the faking task suppressing AB).
- 2) We expected a significant interaction between the type of T1 stimulus (nude male, clothed female) and group (homosexual men, faker) in reporting T2 (i.e., in the homosexual men group the mean accuracy in reporting of T2 would have been lower when T1 was a nude male compared to when T1 was a clothed female and in the faker group the mean accuracy in reporting T2 would have been higher when T1 was a nude male compared to when T1 was a clothed female) (due to AB).

### 12.3 Results

#### **Hypothesis 1 received support**

We found that the accuracy in reporting T2 was higher in the faker group than in the homosexual and heterosexual men group (Figure 23).

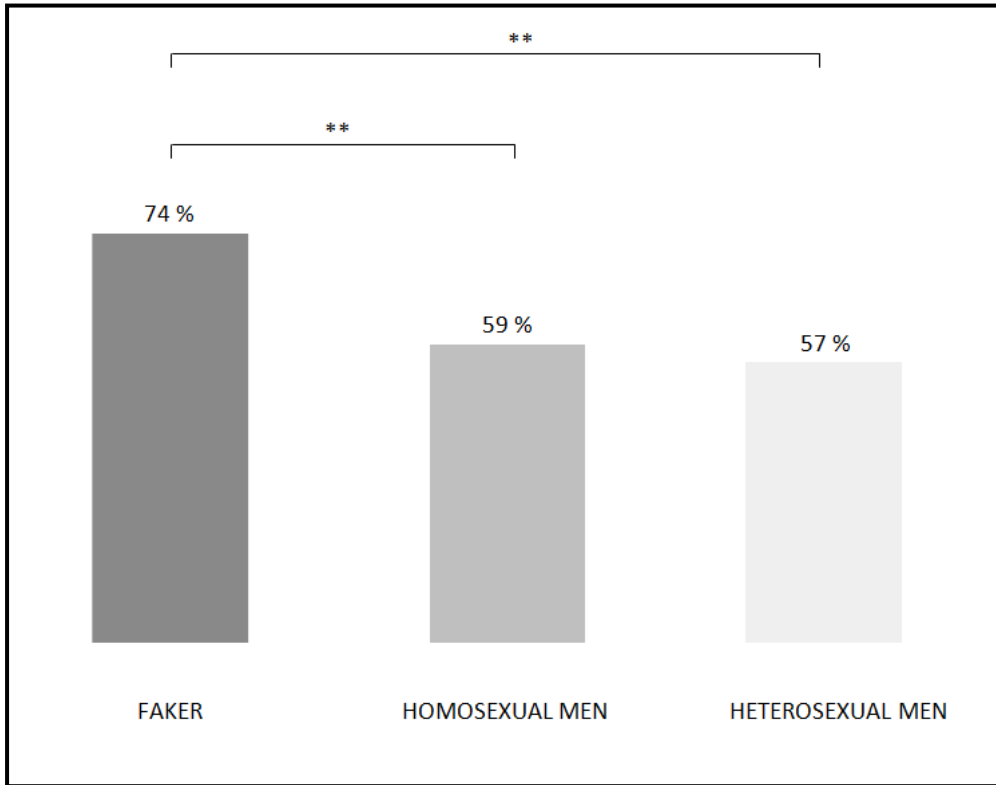


Figure 23. Detection rates of T2 in faker, homosexual and heterosexual men group when T1 was correctly reported.

#### *Discriminatory effectiveness using AB*

We obtained a good separation between homosexual men and fakers ( $AUC = .78$ ,  $p < .05$ ), between heterosexual men and fakers ( $AUC = .81$ ,  $p < .05$ ) and between non-fakers (homosexual men and heterosexual men combined) and fakers ( $AUC = .79$ ,  $p < .05$ ).

#### **Hypothesis 2 received support**

We found a significant difference in the T2 accuracy in reporting T2 between homosexual men and fakers depending on type of T1 stimulus (nude male, clothed female). In the homosexual men group the proportion of accuracy in reporting T2 was lower when T1 was a nude male compared to when T1 was a clothed female. In the

faker group the proportion of accuracy in reporting T2 was higher when T1 was a nude male compare to when T1 was a clothed female (Figure 24).

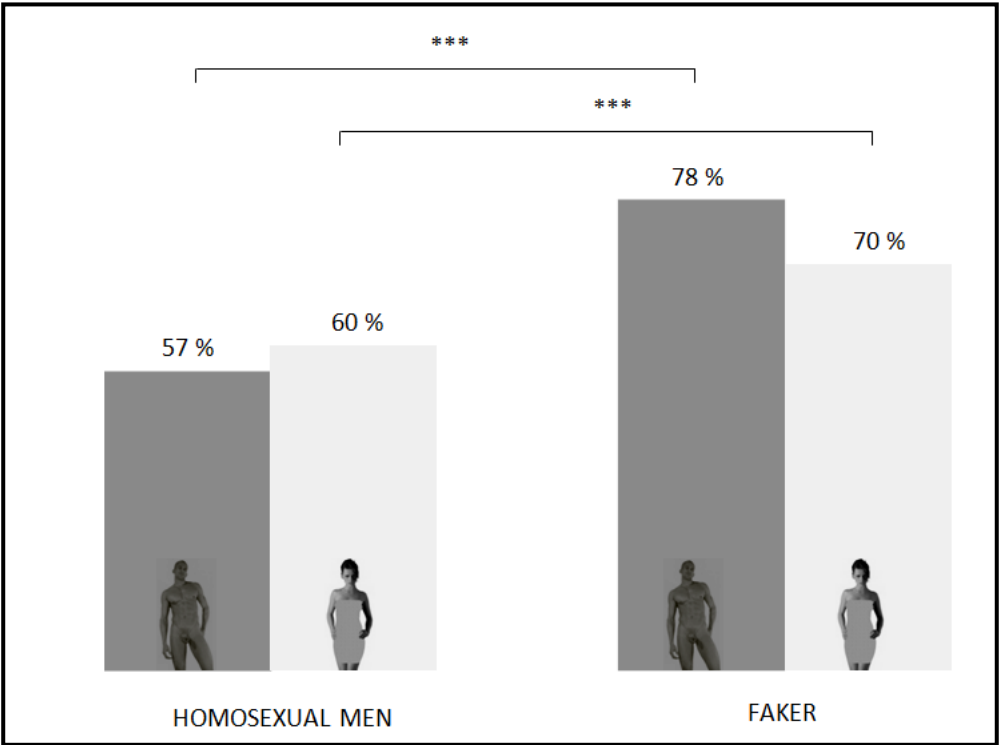


Figure 24. Detection rates of T2 in homosexual and faker group when T1 was correctly reported (the pictures in the box, i.e., male nude and clothed and the female nude and clothed, represent the type of T1).

12.4 Conclusions

Our hypotheses received support by the findings. Detailed analysis of diagnostic properties (ROC analysis) showed a good separation between homosexual men and faker participants. We conclude the dtRSVP as an attentional method of measurement procedure of sexual preference (homosexual men vs. heterosexual men) has a moderate resilience to faking.

## 13 Summary of the results of ROC Analysis

We obtained a high separation between homosexual male and heterosexual male participants (Study I and II) and a good separation between homosexual men and fakers, between heterosexual men and fakers and between non-fakers (homosexual men and heterosexual men combined) and fakers (Study IV). In Study III (using dtRSVP to separate deviant and non-deviant sexual preferences in men) we did not find a sufficient differentiation among groups (Table 2).

Table 2  
Summary of the results of ROC Analysis

Study	Purpose	Indices	ROC Analysis AUC
I	Differentiating sexual preference in men using dtrSVP	T1 index (we subtracted the proportion of correctly identified male T1 from female T1) T2 index (we subtracted the proportion of correctly identified male T2 from female T2), AB Index (we subtracted the proportion of correctly identified T2 when T1 was a female from T2 when T1 was a male. All indices were hypothesized to be positive for heterosexual men and negative for homosexual men. The indices were subjected to a logistic binary regression with sexual preference (homosexual men vs. heterosexual men) as the dependent variable. The obtained probabilities (total index) from this regression analysis were then used as the test variable in an ROC-curve analysis.	.88, $p < .001$
II	Differentiating sexual preference in men using dtrSVP	T1 index, T2 index and total index were calculated in the same way in study I).	.85, $p < .001$
III	Identifying deviant sexual interest in a forensic sex offender population using dtrSVP	T1 index (T2 index ) was calculated subtracting the percentage of T1 (T2) accuracy when it was of preferred gender and maturity level was Tanner 1 from T1 (T2) accuracy when it was of preferred gender and maturity level was Tanner 4/5. AB index was calculated subtracting the percentage of T2 accuracy when correctly reported T1 were of preferred gender and maturity level was Tanner 1 from T2 accuracy when correctly reported T1 were of preferred gender and maturity level was Tanner 4/5. Combine Index was calculated subtracting Pop Out Index 1, Pop Out Index 2 and AB index to a logistic binary regression with sexual preference (pedophile vs. non-pedophile) as the dependent variable.	.66, $p < .05$
IV	Testing the fakeability of dtrSVP as an attention-based measurement procedure of sexual preference	AB Index (we subtracted the proportion of correctly identified of T2 when T1 was a female from T2 when T1 was a male. All indices were hypothesized to be positive for heterosexual men, faker men and negative for homosexual men. The indices were subjected to a logistic binary regression with sexual preference (homosexual men vs. faker men, heterosexual men vs. faker men, non-faker men and heterosexual men and heterosexual men taken together) vs. faker) as the dependent variable.	.78, $p < .05$ .81, $p < .05$ .79, $p < .05$



## 14 STUDY V: SDS-Study (Stimulus Development Study)

### 14.1 Resume

We created a new stimulus set for the assessment of pedophilic sexual preference that takes the ethical and legal concerns as far as possible into account and is largely standardized in order to maximize internal validity for the experimental work.

In study 1, participants were 20 (10 female, 10 male), in study 2, participants were 110 (55 male, 55 female), in study 3, 106 male participants took part in the study. 59 men were sampled from the community (community sample) and 47 individuals were inmates convicted either for a hands-on child sexual abuse offense or for the possession or distribution of child pornography.

### 14.2 Results

Study 1. The overall observer agreement was calculated to an intra class correlation coefficient (ICC; two-way random model, single measure, absolute agreement) of (2, 1) = .87 (95% confidence interval [CI]: [0.83, 0.90]).

The realism ratings for adolescent/adult images were rated as significantly more realistic than images of prepubescent children and of pubescent juveniles ( $p < .001$ )

For the mean attractiveness ratings (again comprising gender, maturity level, and explicitness as factors), the interaction between gender and maturity level proved significant ( $p < .001$ ). Adolescent/adult female stimuli were rated as significantly more attractive than prepubescent female stimuli. Comparisons between the disparate categories of prepubescent and adolescent/adult stimuli were the fastest and significantly quicker than comparisons of prepubescent stimuli with pubescent stimuli ( $p < .001$ ), and also significantly faster than comparisons of pubescent stimuli with adult/adolescent stimuli ( $p < .001$ ).

In sum, both studies indicated that the underlying structure held and that images could be allocated to their assumed level of biological maturity with a high level of accuracy.

Study 3. We found that the interaction effect of group and stimulus maturity level was significant for stimulus ratings (in terms of sexual attractiveness). The same

interaction did not reach statistical significance for mean RTs (in terms of judging the images for realism).

The level of observer agreement among the child sexual abusers was very similar to the agreement among the community controls. The ICCs ranged from .58 (for images of clothed females) to .79.

Mean ratings of the 108 pictures for realism and attractiveness, averaged across all participants, were significantly correlated at  $r = .71$  ( $p < .001$ , one sided).

### 14.3 Conclusions

We concluded that the VPS appears to be a potentially useful stimulus set for experimental research into pedophilic sexual interest. However, it is yet unclear whether the pictures really serve the purpose they were designed for, i.e. measuring sexual preference and pedophilia in particular. Consequently, the validity of the VPS still remains to be tested.

## 15 Discussion

The main aim of this thesis was to develop a procedure using a dual-target Rapid Serial Visual Presentation (dtRSVP) procedure for identifying Deviant Sexual Preference (DSP) through the evaluation of the magnitude of the Attentional Blink (AB) and of the Pop Out effect.

The results showed that pedophilic male participants processed sexual stimuli differently in comparison to non-pedophilic male participants and these differences were in the expected directions. Based on these studies, we nevertheless found it difficult to reach any conclusions about this measurement procedure's ability to differentiate between groups (pedophilic vs. non-pedophilic). Other intermediate outcomes were that sexually preferred stimuli affected the information processing in a predictable way and that the procedure had a good capacity to differentiate sexual preference between homosexual men and heterosexual men. Finally, we also found that the procedure had a moderate resilience to faking in groups of homosexual men, heterosexual men and heterosexual men instructed to fake their sexual preference.

The current studies contributed with some elements of originality and novelty to the research agenda on attentional methods in measuring DSP in general and the use of the RSVP paradigm in particular. These elements are: 1) investigating the fakeability of dtRSVP; 2) exploring the use of the VPS as visual stimuli; 3) using only stimuli depicting humans (which varied in term of maturity level in Study II and III); 4) investigating if and how real-life sexual preference moderated information processing of both sexually relevant stimuli; and finally 5) using a large sample of child sex offenders in comparison to earlier studies.

Before testing the dtRSVP in a forensic population of sex offenders, we conducted two studies in order to calibrate the procedure. We made the analogy that if the procedure would have been able to differentiate between types of non-DSP (homosexual men vs. heterosexual men) then it could also be used to identify DSP in forensic population (child sex offenders, sexual offenders, non sex offenders, community control). The assumption of an analogy between non-DSP and DSP was based on the aesthetic response as conceptualized by Singer (1984) (i.e., as an

automatic emotional reaction to an object, leading to an increased attention towards the object of attraction)<sup>26</sup>. In other words, we hypothesized that the “hedonic feelings in response to a sexual stimulus” (Singer, 1984) and the psychological mechanisms involved in evaluating sexually attractive targets are the same for homosexual men, heterosexual men and for men with DSP. Heterosexual men have a higher genital response and self-reported sexual arousal in response to visual sexual stimuli sexually of a specific class (i.e., women) whereas homosexual men have the reverse pattern (i.e., preferring men) (Chivers, Rieger, Latty, & Bailey, 2004; Freund, 1963 in Safron et al., 2007). However, even if heterosexual men and homosexual men are sexually aroused by different categories of sexual stimuli, studies have shown that homosexual men and heterosexual men report similar interests in uncommitted sex and visual sexual stimuli, and value physical attractiveness to similar degrees (Bailey, Gaulin, Agyei, & Gladue, 1994 in Safron, 2007) and that men of both orientations show category-specific sexual arousal to visual sexual stimuli. These findings indicate that the elements determining the differences in sexual preference may not produce differences in other aspects of sexuality<sup>27</sup>.

Concerning our studies, this means that during the view of stream of visual stimuli in a dtRSVP, participant’s attention is captured by the stimuli that are emotionally arousing in terms of sexual preferred in a similar way for homosexual men, heterosexual men and participants with DSP. So, homosexual male participants will

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<sup>26</sup> Regarding the analogy between non-DSP and DSP in terms of the aesthetic response, it should be noted that Polisois-Keating and Joyal (2013), in a recent meta-analysis, comparing functional neuroimaging of sexual arousal pedophilic to non-pedophilic men, found that all activated brain regions associated with sexual arousal in the non-pedophilic group were also found in the pedophilic group and no significant differences emerged between the groups (even if the number of significant foci was higher in the pedophilic group).

<sup>27</sup> Russock (2011), in an analysis of 800 personal advertisements from print and online media used to determine the mate selection criteria of four mating groups — males seeking females (MF), females seeking males (FM), males seeking males (MM) and females seeking females (FF), found that homosexual males (MM) differed from heterosexual males regarding only two criteria, both of which exhibited an exaggerated male pattern, possibly because MM are unaffected by the sexual strategies of females; MM sought attractiveness (even) more than MF and offered resources less than MF. Homosexual men, thus, exhibited no evidence of selection on the mate preference characteristics predicted by sexual selection theory. Gobrogge, Perkins, Baker, Balcer, Breedlove, and Klump (2007) examined 439 homosexual and 365 heterosexual men who placed internet ads. Significantly more homosexual men than heterosexual men sought sexual encounters, although men (regardless of sexual orientation) seeking sexual encounters preferred a significantly wider age range of partners than men seeking longer-term relationships. These findings suggest that partner preferences are independent of evolutionary drives to procreate, since both types of men preferred similar ages in their partners.

find pictures of males more emotionally arousing than pictures of females, heterosexual male participants will find pictures of females more emotionally arousing than pictures of males and participants who have a DSP will find pictures of prepubescents more emotionally arousing than pictures of adults.

Previous studies designed to discriminate between participants with respect to sexual preference (homosexual men vs. heterosexual men) have found that the response latency is longer for sexually relevant visual stimuli as compared to sexually irrelevant stimuli and viewing time measures discriminated between participants (homosexual men vs. heterosexual men, Zamansky, 1956; heterosexual men and women, Israel & Strassberg, 2009; Quinsey, Ketsetzis, Earls, & Karamanoukan, 1996; Wright & Adams, 1994). In all these studies “the rationale underlying the test is that clients will look longer at pictures they find sexually attractive” (Laws & Gress, 2004, p. 184). Differently from these studies, we explored if the dtRSVP procedure could differentiate between types of non DSP (homosexual men vs. heterosexual men) and if the Virtual People Set (VPS) could be used as a stimuli in the procedure. To our knowledge no other studies have been published on using the dtRSVP as an attention-based measurement procedure to differentiate sexual preference in a sample of homosexual men and heterosexual men.

In Study I, in a group of homosexual men and heterosexual men, we investigated if and how real-life sexual preference moderated information processing of sexually relevant photos of men and women (clothed and nude) presented as a target one (T1) and a subsequent target two (T2) in a dual-target Rapid Serial Visual Presentation task (dtRSVP).

In Study II, in a group of homosexual men and heterosexual men, we investigated if and how sexually relevant visual stimuli (computer generated images of both males and females) varying in terms of explicitness (clothed and nude) and in terms of sexual maturity, affected information processing of both a target one (T1) and a subsequent target two (T2) in a dtRSVP when used as an attention-based measurement procedure of sexual preference.

Both in Study I and Study II, we found a Pop Out effect. In Study I, we found an increase in T1 (T2) accuracy when T1 (T2) was a sexually preferred image compared

to when T1 (T2) was not a preferred image. Homosexual men had an increased T1 (T2) accuracy when T1 (T2) was male compared to when if T1 (T2) was female and heterosexual men had an increased T1 (T2) accuracy when T1 (T2) was female compared to when if T1 (T2) was male. Thus, we found that real-life sexual preference moderated the detection rates of sexual stimuli in the dtRSVP observing a Pop Out effect on target detection rates of both T1 and T2, suggesting a facilitation of information processing of sexual stimuli that corresponds to real-life sexual preference.

In Study 2, we had similar findings regarding the Pop Out effect. The accuracy in reporting T1 and T2 was again relatively increased when T1 and T2 were sexually preferred, compared to when they were not.

Regarding the Pop Out effect, it should be noted that, on the one hand, the pop out effect is commonly thought to have a “bottom-up” influence, where there is something about the stimulus that effectively makes it pop out. An example of this in the context of the present studies is nudity. On the other hand, the Pop Out effect can sometimes have a “top-down” influence, in that, there is something about the observer that leads a certain stimulus to seemingly Pop Out. In this case, sexual preference appears to be a factor in causing male images (for homosexual male participants) or female images (for heterosexual male participants) to “pop out”.

The expected increased T1 and T2 accuracy when they belonged to the preferred gender and preferred maturity level supports the information-processing approach to human sexuality (Everaerd, 1995; Geer et al., 1993) and is generally in line with previous research suggesting that salient stimuli capture attention, leading to better performance and more accurate reporting of affectively arousing versus non-arousing stimuli (Vuilleumier, 2005).

Our findings are fully in line with the aesthetic response, conceptualized by Singer (1984) as an automatic emotional reaction to an object, leading to an increased attention towards the object of attraction. Studies have shown that to process emotionally arousing (Anderson, 2005; Arnell et al., 2007) stimuli less attentional resources are needed. Furthermore, these findings were in line with expectations derived from the model of preattentive selection of sexual features (Spiering &

Everaerd, 2007). The preattentive process can be thought of as a parallel, automatic and fast process of filtering stimuli with specific features. Spiering and Everaerd (2007) define the preattentive selection of sexual features as a process in which sexual features may be preattentively selected to trigger focal attention. In terms of sexual preferences, this means that sexually preferred stimuli are more salient for the participants compared to when they are not sexually preferred. Moreover, we found that real-life sexual preference moderated the detection rates of sexual stimuli in the dtRSVP. We observed a Pop Out effect on target detection rates of both T1 and T2, suggesting a facilitation of information processing of sexual stimuli that corresponds to real-life sexual preference.

In light of this, we concluded that sexually relevant stimuli affect the information processing in a predictable way inducing a Pop Out effect. Our findings suggest that the Pop Out effect in dtRSVP task using computer generated images (images of adult, adolescent, pubescent, and prepubescent, males and females, nude and clothed) can be used to differentiate between types of sexual preference (homosexual men vs. heterosexual men).

In Study I we found an AB. We found a decrease in the correct identification of T2 when a correctly reported T1 was a sexually preferred image compared to when T1 was not sexually preferred. We found that homosexual men had a decreased T2 accuracy when T1 was male compared to when T1 was female, and heterosexual men had a decreased T2 accuracy when T1 was female compared to when T1 was male. The findings of Study I are in line with previous studies that have shown that AB is increased when T1 has an emotional valence (in our study the emotional valence was the sexual preference of the stimuli) to the viewer.

Our studies (I, II, III and IV) did not focus on the investigation of the causes and the underlying mechanisms of the attentional blink (for example, we did not change the time interval between the presentation of T1 and T2 and the number of the distractors stimuli across the studies<sup>28</sup>). Moreover, the presentation time of the stimuli was kept constant and the procedures were always of dual-target type. Consequently,

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<sup>28</sup> Our choice to limit to one intra-stimulus image was due to keeping the experiment feasibly short, while including many important aspects in terms of stimulus valence. In fact, varying the intra stimulus image from 1 to 6 stimuli would lengthen the duration the test near to 3 hours.

our results do not help to resolve whether the cause of the AB is due to the misallocation of resources or to an insufficiency in the overall amount of resources or to the lack of sufficient resources to bring two targets in close temporal proximity into awareness (see Yang-Ming, Baddeley, & Young, 2008). However, it should be noted that recently Lagroix et al. (2012) found support to the T1-based theories of the AB. Differently from the distractor-based theories, that claim that the presence of at least one distractor following T1 is regarded as necessary to induce AB, T1-based theories claim that T1 processing alone is sufficient to cause the AB. Our findings are consistent with T1-based models of the AB that generally agree that attending to and encoding a T1 reduces the attentional resources required to encode a T2 into conscious awareness (Chun & Potter, 1995). It could be hypothesized that T1 sexually preferred stimuli received more than their share of attentional resources in RSVP and were preferentially encoded into awareness and this provoked a deficit in identification of a subsequent target appearing within about half a second.

In Study II we did not find an AB. We conjecture that the different results between the studies I and II was due to the different set of used stimuli. In Study I we used photos of only adult models clothed or nude, downloaded from pornographic Internet pay sites whereas in Study II we used computer generated images of nude adults and children (clothed or nude). Therefore, differently from the participants in study I, study II's participants had to perform a more complex process because here the stimuli also varied in terms of sexual maturity. The cognitive load of this more complex processing could have decreased the magnitude of AB. In addition, we think that the attractiveness of the stimuli in Study II was lower in comparison to the stimuli of Study I. Consequently, we think that the stimuli of Study I could have had a lower capacity to engage the participant's attentional resources in comparison to those of Study I. In other words, in Study II, T1 depicting males or females could be attractive enough to induce Pop Out for homosexual and heterosexual men but not enough arousing to induce an AB.

Despite the absence of AB in Study II, in light of our results, we concluded that dtRSVP can be used as an attention-based measurement procedure to differentiate sexual preference in a sample of homosexual men and heterosexual men. We obtained



a high (Study I) and good (Study II) separation between homosexual male and heterosexual male participants.

In Study III, we investigated if and how sexually relevant visual stimuli affect information processing of both a target one (T1) and a subsequent target two (T2) in a dtRSVP when used as an attention-based measurement procedure of DSP in a forensic population.

In Study III we found a Pop Out effect, that is, a better accuracy in reporting T1 and T2 when they were more salient in terms of gender and maturity level, compared to when they were not. We found a T1 (T2) Preferred Gender X T1 (T2) Preferred Maturity Level interaction, such that when T1 (T2) was of preferred gender and maturity level<sup>29</sup>, the accuracy in reporting them was higher in comparison to when they were not. These findings can be interpreted in the same way as the Pop Out effect found in Study I and II. In Study III, we did not find an AB when we considered the interaction between T1 preferred gender and preferred maturity level on the accuracy in reporting T2. Similarly, to the findings in Study II, we think that these findings can be explained in a similar way.

However, differently from Study I and II, we wanted to explore the possibility to identify deviant sexual preference in a forensic population. Since some participants in the Child Sexual Offender group had committed crimes against children older than 11 years, we wanted to see if the ability of this test was useful for identifying a group of pedophilic men. To do this, we evaluated the magnitude of AB when the T1 was of preferred gender and maturity level. Thus we evaluated the accuracy in reporting T2 when the maturity level of T1 belonged to the Tanner 1 category and the participant had an SSPI value greater than 2. In this case, we found an interaction, such that the highest detection rate for T2 being observed when the T1 was neither of the preferred gender nor of the preferred maturity level. Our findings can be interpreted in light of the bipolar model of alloerotic responding (sexual responding to other people) (Blanchard, Kuban, Blak, Klassen, Dickey, & Cantor, 2012). Blanchard et al. (2012) argue that there are two models of sexual responding: the first one (“summation

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<sup>29</sup>A dichotomous variable named Pedophile Preferred was set to 1 if the maturity level of the stimulus belonged to Tanner 1 category and the participant had a Screening Scale for Pedophilic Interests value greater than 2.

model”) relies on the idea that men are attracted and respond to a possible sexual object as a stimulus that “sum” gender and age components; the second one (“bipolar model”) relies on the idea that men are attracted and respond to a possible sexual object as a gestalt. In their study, Blanchard et al. (2012) found evidence that supported the bipolar model (i.e., men respond to a potential sexual object as a gestalt, not as a compound stimulus made up of an age component and a separate gender component). In light of this, we could reformulate our hypothesis in terms of the bipolar model of sexual responding. Thus, the original hypothesis predicting that “an AB occurs when correctly reported T1 are of preferred gender and maturity level” become “an AB occurs when correctly reported T1 are sexual interesting in terms of bipolar model (i.e., the gestalt of stimuli).” According to that, we found evidence that support this hypothesis.

In Study IV, we tested whether dtRSVP is resilient to faking in a group of homosexual men, heterosexual men and heterosexual men instructed to fake their T2 responses assuming the expected response style of homosexual men. We found an AB in two conditions. The first one was when we evaluated the different accuracy in reporting T2 when T1 was accurately reported, we observed that the faker group reported T2 more accurately compared to the homosexual men and the heterosexual men.

This could be explained by them being affected in detection by the faking task cognitive load reduced AB phenomenon as shown by Olivers and Nieuwenhuis (2005). Olivers and Nieuwenhuis (2005) found a reduced AB in an RSVP when observers are concurrently engaged in distracting mental activity (freely associating on a task-irrelevant theme or listening to music). In a subsequent study, Olivers and Nieuwenhuis (2006) found a reduced AB when participants concurrently performed an additional memory task, viewed pictures of positive affective content, or were instructed to focus less on the task.

The second condition where we found an AB was when we found a significant difference in the T2 accuracy between homosexual men and fakers depending on the type of T1 stimulus (nude male, clothed female).

We found differences in the T2 accuracy between the homosexual men and faker groups depending on the type of T1. We expected that for homosexual men, a nude male T1 is more attractive than a clothed female T1 and therefore we decided to compare the reactions of the fakers with those of homosexual men when T1 was either a nude male or a clothed female. We found that for homosexual men the T2 accuracy was lower when T1 was a nude male compared to when T1 was a clothed female. We found that the heterosexual faker group was not able to simulate the same pattern of responses. These findings are in line with the previous studies that have found that AB is increased when T1 has an emotional valence (i.e., nude stimuli is more emotional than clothed) (Anderson, 2005; Schimmack & Derryberry, 2005; Most, Chun, Widders, & Zald, 2005; McHugo, Olatunji, & Zald, 2013).

We obtained a good separation between homosexual men and fakers, between heterosexual men and fakers and between non-fakers (homosexual men and heterosexual men combined) and fakers. We conclude that the dtRSVP as an attention-based measurement procedure of sexual preference (homosexual men vs. heterosexual men) has a moderate resilience to faking.

In sum, when we used dtRSVP as an attention-based measurement procedure to differentiate sexual preference in a sample of homosexual men and heterosexual men we found that: sexually preferred stimuli affected the information processing in a predictable way and that the procedure had a good capacity to differentiate sexual preference between the groups; real-life sexual preference moderated the detection rates of sexual stimuli and that the procedure had a moderate resilience to faking. We also found that Virtual People Set appears to be a potentially useful stimulus set for experimental research into pedophilic sexual interest. When we used the dtRSVP as an attention-based measurement procedure for identifying deviant sexual preference in a forensic population, we found that pedophilic participants showed different styles in processing of sexual stimuli in comparison to non-pedophilic participants and these differences were in the expected directions. However, we found that it was difficult to reach any conclusions on this measurement procedure's ability to differentiate between the groups (pedophile vs. non-pedophile).

Our promising findings suggest that it is important to continue the research on attention-based measures of DSP in general and dtRSVP in particular. Future research should focus on making dtRSVP procedure a reliable tool for identifying deviant sexual preference. This procedure has a few important benefits in comparison to PPG: it is less intrusive, easy to standardize, it is cheap, and it is difficult to successfully fake the outcome. dtRSVP could be used together with other attention-based measurement procedures (for example choice reaction time or viewing time) or implicit association tests and these could be administered as a battery of measurements for identifying deviant sexual preference.

## 16 Future directions

Several points could be considered in order to increase the efficacy of using the dtRSVP procedure to identify DSP.

### *Improve the quality of the stimuli*

All the attention-based measurement procedure to identify deviant sexual preference, dtRSVP included, use the aesthetic response of the participants and work through discriminating the effect of increased attention towards sexually relevant stimuli upon information processing tasks. The aesthetic response depends not only on the shape of the body and/or quality of the texture of the skin, but also the attractiveness of the depicted individuals. Recently, Nakamura and Kawabata (2014) investigating the temporal modulation of visual attention induced by facial attractiveness, found that the identification of a second female target (T2) was impaired when a first target (T1) was attractive compared to neutral or unattractive. Therefore, considering that the visual stimuli play an important role to elicit the aesthetic response, the quality of stimuli ought to be further improved.

### *Participant's sexual desire level*

It has been shown that the emotional state of participants affects the accessibility of highly valued or goal-relevant stimuli (Förster, Liberman, & Friedman, 2007), which may enhance perceptual awareness (Anderson, 2005; Anderson & Phelps, 2001; Bruner & Goodman, 1947; Vuilleumier, 2005). For example, food-related words are easier to recognize when one is hungry than when one is not (Radel & Clément-Guillotin, 2012; see also Balcetis, Dunning, & Granot, 2012) (in Gantman & Van Bavel, 2014). In addition, Conaglen (2004) found that individuals with lower levels of sexual desire responded more slowly to sexual stimuli than other participants, and rated sexual words as less familiar, less acceptable, and less positive emotional.. These findings suggest that the information processing of sexual information could be affected by sexual desire. Therefore, the “wishful seeing” phenomenon and participant's sexual desire level should be investigated.

### *Participant's mood state*

A few studies investigated the relation between the mood state of the participants and the magnitude of the attentional blink in the RSVP procedure. Jefferies, Smilek, Eich, and Enns (2008) found that sadness (low arousal with negative affect) produced the highest levels of performance (i.e., a largest attentional blink), anxiety (high arousal with negative affect) led to the lowest levels of performance. MacLean, Arnell, and Busseri (2010) found that higher levels of negative trait (self-reported) affect were associated with a greater attentional blink and that the magnitude of the attentional blink was negatively correlated with trait positive affect. MacLean et al. (2010) found a smaller attentional blink that was associated to a greater dispositional positive affect and a larger attentional blink that was associated to a greater negative trait (similar findings were found relating to depression Rokke, Arnell, Koch, & Andrews, 2002). Recently Kawahara and Sato (2013), found that negative mood affect the magnitude of the attentional blink (negative mood was associated to a larger attentional blink). They postulated that these findings could be explained by that attentional blink phenomenon could be due to a limitation in the resources available for consolidating the second target into working memory. Since negative mood states impair the encoding of events into working memory (e.g., Schoofs, Wolf, & Smeets, 2009) negative mood increase the magnitude of the attentional blink. In addition, it should be noted that it has been suggested that depression is associated with reduced attentional functioning (Hasher & Zacks, 1979). Rokke, Arnell, Koch, and Andrews (2002) observed that a large body of literature supports the proposition that depression is associated with limitations in the effortful processing of information in memory tasks.

Regarding the effect of the participants' mood on the AB, MacLean, Arnell, and Busseri (2010) found that higher levels of self-reported negative trait, were associated with a greater attentional blink and Rokke et al. (2002), for a similar finding related to depression. Moreover, MacLean, and Arnell (2010) found that greater dispositional positive affect was associated with a smaller attentional blink, whereas greater negative trait affect was associated with a larger attentional blink (see also Kawahara & Sato, 2013).

These findings suggest that the issue of the participant's mood should be further investigated.

### *Faking*

In our study of the fakeability we were limited to a non-deviant sexual preference of a non-forensic sample. It would be necessary to investigate if our findings can be generalized to a forensic population (i.e., child sex offender) and to explore if the results are invariant to deliberate variations in the test person's performance and if the test's usefulness is maintained when the test-taker acquires knowledge about the test (Fiedler & Bluemke, 2005).

### *Participant's stress*

A couple of studies investigated the relation between stress of the participants and the magnitude of the attentional blink in the RSVP procedure. Schwabe and Wolf (2010) found that stress had no effect on the attentional blink while Kawahara and Sato (2013) found that stress manipulation increased the magnitude of the attentional blink deficit. The forensic setting, where the procedure could be applied, could be anxiety-provoking and stressful. In light of these considerations, the effect of stress needs further investigation.

### *Test-Retest*

An objective assessment of the presence of deviant sexual preference would allow evaluating the progress of treatment as well as confronting patients who are in denial about their sexual interests. In order to evaluate the efficacy of the treatment of child sex offenders, it would be expected that the magnitude of the AB should be different before and after treatment (i.e., before the treatment, a greater magnitude of AB is expected in comparison with after the treatment). Consequently, the re-testability feature for RSVP is crucial.

We reported positive findings of Flak's study (2011) that support the re-testability of RSVP. However, it should be noted that there are some studies that have investigated the possibility to eliminate AB through repetitive practice (Braun, 1998; Maki & Padmanabhan, 1994; Taatgen, Juvina, Schipper, Borst, & Martens, 2009).

Recently, Choi, Chang, Shibata, Sasaki, and Watanabe (2012) found that “(...) just 1 h of specific attention training can completely eliminate AB, and that this effect is robust enough to persist for a few months after training (...)” and Tang, Badcock, and Visser (2014) found that “whereas training may ameliorate the AB indirectly, the processing limits evidenced in the AB cannot be directly eliminated by brief exposure to the task.”

These recent findings suggest that the issue of the test-retest should be further investigated.

*Exploring the deviant sexual interest in female sexual offender through attention-based measurement procedure*

Even if female sexual offenders (FSO) are rare (criminal justice data show that FSO are about 5% of all sexual offenders; Cortoni & Hanson, 2005; Cortoni, Hanson, & Coache, 2009)<sup>30</sup> and the recidivism rate of FSO are less than 3% (Cortoni, Hanson, & Coache, 2010) the issue of the how to conduct a forensic assessment of the FSO remains.

It has been stated (Cortoni, 2010) “that a simple transfer of knowledge from the male sexual offender literature to females is simply not appropriate”. So even if the Deviant Sexual Preference (DSP) has been found to be one of the most important predictors of sexual offence recidivism for males, the role of the Deviant Sexual Preference (DSP) in female sexual offenders has not been studied yet.

However, a research programme aimed at investigating the possibility to create an attention-based measurement procedure to identify DSP in FSO, should consider that:

“Women, on average, report increased sexual arousal to both preferred and non-preferred sexual stimuli (Schmidt, 1975; Chivers et al., 2004; Laan et al., 1996), which suggests that cognitive and affective responses to sexual stimuli are not dependent upon sexual stimuli depicting a preferred sexual interest. Exposure to preferred and non-

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<sup>30</sup> In a two victim survey it was found that 6% to 14% of abused girls and 14% to 24% of male child victims were sexually abused by a female (Green, 1999) and that as many as 39% of men and 6% of women reported being sexually abused in childhood by a female (Dube et al., 2005).



preferred sexual stimuli results in similar rates of masturbation and partnered sexual behaviours among women, in contrast to men (Schmidt, 1975). This suggests that among women, the motivation for engaging in sexual behaviour is also less dependent upon “exposure to preferred sexual stimuli.” (Chivers, 2005).

## 17 Limitations

There are several limitations with the present study that should be acknowledged. A few of these affect all studies. One limitation regards the Pop Out Effect (POE). It should be noted that even though Spiering and Everaerd (2007) have presented a model according to which sexual features of a target are pre-attentively selected to focal attention. Thus, describing this phenomenon as a POE in the context of dtRSVP may not be entirely accurate considering that in the original formulation, a POE refers to a stimulus having a feature singleton in a spatial as opposed to a temporal display. However, we suggest that secondary sexual characteristics could be conceptualized as such feature singletons. Another limitation regards the Attentional Blink (AB). The AB is usually described as a lag-dependent reduction in T2 accuracy, therefore no AB can be demonstrated if not at least one short and one long lag are used. In our study the distance between the T1 and the T2 was set to one intra-stimulus image, thus measuring an arbitrary point in the AB at 166 ms. It would be useful to vary the distance between T1 and T2 in order to understand how sexual salience of the stimuli T1 and T2 modulates the AB phenomenon. Our choice to limit to one intra-stimulus image was due to keeping the experiment feasibly short, while including many important aspects in terms of stimulus valence. In fact, varying the intra-stimulus distance from 1 to 6 would have lengthened the duration of the dtRSVP procedure to nearly 3 hours. Moreover, we did not empirically test whether participants were unaware of the property (sexual preference) that we measured and we did not consider the anxiety factor in the participants. Finally, the level of sexual desire in the participants should have been considered. Conaglen (2004) found that the Sexual Content Induced Delay phenomenon (i.e. a hesitancy in decision making related to erotic material (Geer & Bellard, 1996; Geer & Melton, 1997), was demonstrated by both men and women in a study with no significant variation between the genders. However, individuals with lower levels of sexual desire responded more slowly to sexual stimuli than other participants, and rated sexual words as less familiar, less acceptable, and less positive. These findings suggest that the information processing of sexual information could be affected by the sexual desire. Finally, it would be

necessary to explore if the results of dtRSVP are invariant to deliberate variations in the participants' performance and if the test's usefulness is maintained when test-taker acquire knowledge about the test (Fiedler & Bluemke, 2005).

A few limitations affect the studies conducted on the non-forensic population. In Study I, Study II and IV, we obtained statistically significant results but the number of participants was small and the generalizability of the results should, therefore, be regarded with caution.

In Study IV the motivation to successfully fake is presumably much lower among our participants than in forensic assessment situation, and thus the ecological validity of the test is hampered.

Finally, a few limitations affect the Study III. First of all, it should be noted that this study assumes that sexual preferences are relatively categorical based on gender (male/female) and Tanner stage (1 vs. 4/5). Differently from this categorical perspective on sexual interest, Blanchard et al. (2012) argued for a continuum from adult male, youth male, child male, child female, youth female and adult female. Blanchard's model, however, would lead to quite different predictions. Instead of one preferred category, there would then be a range of preferred stimuli. For many pedophilic men, there would not be a large difference expected between boys and girls; in contrast, large differences would be expected between men and women for both heterosexual male and homosexual male participants.

Moreover, Study III could have been strengthened by better assessments of pedophilia. Using SSPI scores is reasonable, but a cut-of-score of 2 does not give high levels of absolute agreement with other measures of pedophilia, such as DSM criteria, phallometric responses, or viewing time measures. The faking problem must also be considered. Even though we found that dtRSVP as an attention-based measurement procedure of sexual interest showed moderate resilience to faking (Study IV), it should be considered that in forensic assessments of sex offenders, it is likely that the motivation for deliberately influencing the outcome is higher (Fazio & Olson, 2003). The motivation to fake the results is stronger for the sexual offender during forensic assessment compared to volunteering participants and non sex offenders in experimental condition that is "consequence free".

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